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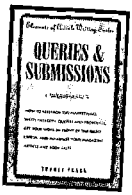

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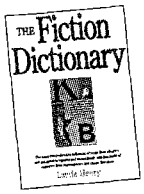

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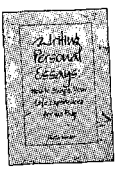

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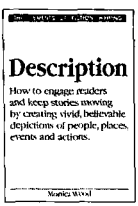
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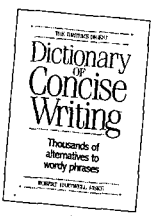

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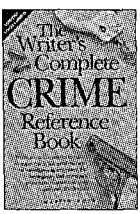

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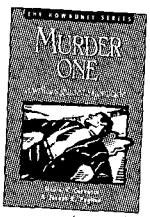

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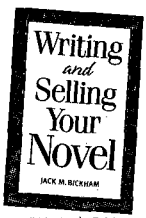

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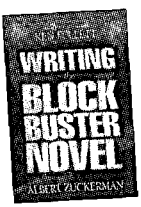

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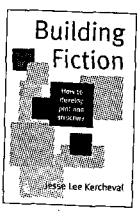

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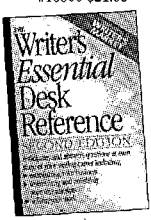

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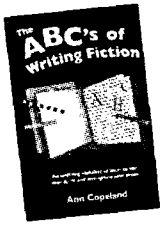

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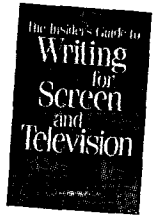

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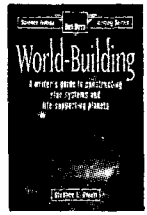

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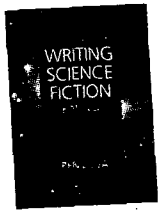

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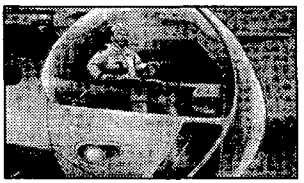

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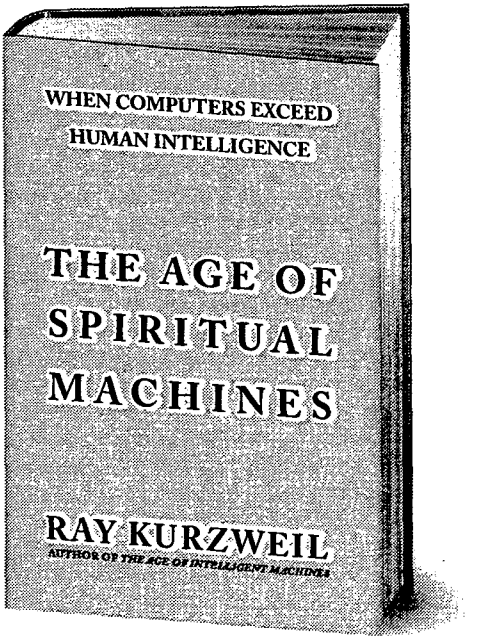
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EDITORIAL Stanley Schmidt

ONE CRYSTAL BALL, SLIGHTLY USED

Science fiction writers, contrary to a popular misconception, are not in the business of predicting the future. As Frederik Pohl put it in the introduction to an anthology some years ago, "The mistake you must never make about science fiction is in thinking that, because it is about the future, it is necessarily about *the* future." We are instead in the business of imagining *possible* futures. Our stories are, in a sense, "trial runs" that might help all of us decide which possibilities we'd like to steer toward, and which we'd like to avoid.

Nonetheless, there is a certain satisfaction in saying, "I told you so!" when one of our imaginings comes true; and there are those (often outside science fiction) who do try to predict what sort of future is most likely. Sometimes it's fun to look back at one of those attempts at prediction and see just how well it did—to compare "the way the future was" (sorry, Fred!) with the way it is.

Such an opportunity recently fell into my lap when my friend Bruce Frumker presented me with a February 1950 issue of *Popular Mechanics Magazine* that he had picked up at a flea market. Prominently blurbed on the cover was an article on "Miracles You'll See in the Next Fifty Years," by Waldemar Kaempffert, then Science Editor of *The New York Times*.

Mr. Kaempffert wisely acknowledged early in the piece that he wasn't going to describe exactly How the Future Would Be, either, though apparently he did expect to come pretty close. "The only obstacles to accurate prophecy," he wrote, "are the vested interests, which may retard progress for economic reasons, tradition, conservatism, labor-union policies and legislation. If we confine ourselves to processes and inventions that are now being hatched in the laboratory, we shall not wander too far from reality."

Well, we shall see. Since we are very near the end of the fifty years he was talking about, this seems a good time to take a look at how he did. We'll find that he did pretty well on some things, and not so well on others—partly because he underestimated just how complex and powerful those "only obstacles" could be, and partly because they *aren't* really the *only* obstacles.

Some things the article hit so close to right that it would seem nitpicking to quibble about the details it missed. It was quite right, for example, about lighter metals (such as aluminum) and synthetics (such as plastics) replacing steel as a structural material in many applications. It also did quite well in foreseeing the prevalence of frozen foods and microwave ovens (though the latter was identified only as "the electronic industrial stove which came out of World War II"). It took for granted that the

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Dobsons, the "typical family of 2000" used as an example throughout the article, would have a television set.

But it then added, "It is connected with the telephones as well as with the radio receiver, so that when Joe Dobson and a friend . . . talk over the telephone they also see each other." That option has been *available* for some time now, but very few people have chosen to use it. Businessmen do have video teleconferences, as the article foresaw, and there are shopping networks on television. But so far, to the best of my knowledge, they haven't reached the point of salespeople holding up samples for individual consumers to examine and ask questions about.

And there's no suggestion in the article that those television images are in *color*, or that radio and television developed in different directions as separate and independent media.

Some things the article got conspicuously wrong. We do not "clean house by simply turning the hose on everything," and it does not seem likely that we will in the foreseeable future. We do not all use personal helicopters for most of our family transportation, and that, too, now seems unlikely. Piloting any aircraft requires considerably more complicated skills than driving a car, and it's difficult to see how available airspace could safely accommodate that density of traffic even if the vehicles themselves could be made idiot-proof.

We do not have nuclear-powered ocean liners and we do not seem likely to any time soon—not because of technical infeasibility, but because of prevailing beliefs about safety of such things (and because most people now consider ships too slow). Supersonic planes exist, but because of their expense and environmental problems receive very limited use. The article imagines that in 2000 "nobody has yet circumnavigated the moon in a rocket space ship, but the idea is not laughed down." How, I wonder, would the author have reacted to the suggestion that in the real 2000 men would have *walked* on the moon so long ago—and with so little of the logical follow-up—that much of the population can't even remember it?

We do forecast and track hurricanes with an accuracy barely dreamed of in 1950, but we do not defuse or divert them by spreading gigantic oil slicks on the ocean and setting fire to them.

In medicine, the article correctly anticipated great improvements and increases in the use of antibiotics and medical instrumentation. It contains no hint of the evolution of antibiotic-resistant strains of bacteria—or of open-heart surgery and organ transplants (though it does hint at pacemakers). It suggests that "such virus diseases as influenza, the common cold, poliomyelitis, and a dozen others are cured with ease." I have the feeling the author would be surprised to learn that the common cold must still be endured, while polio is almost totally *prevented* in developed re-

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gions. And there's no hint of the genetic engineering which now looks like so much of the future of medicine.

The article did foresee the greatly increased automation of industry, in ways that now seem an odd blend of going too far and not going far enough. It describes a helicopter factory in which "electronic inventions that seem to have something like intelligence integrate industrial production so that all the machines in a factory work as units in what is actually a single, colossal organism." They're digitally controlled, but by holes punched in paper tape. The only humans to be seen in the plant are "a few trouble shooters . . . [who] respond to lights that flare up on a board whenever a vacuum tube burns out or there is a short circuit."

And that image leads us neatly to what is, for me, perhaps the most intriguing part of this package of predictions: the things it missed entirely. This automated factory was quite visionary fifty years ago, but it never imagined that punched tape would seem quaint or that there would be no vacuum tubes to burn out. A really demanding critic might fault the author slightly for that last point, for the transistor *had* been invented—but only three years earlier.

The large-scale integration of circuits that led to the microchip would have seemed an extremely farfetched dream to most engineers in 1950. So this article utterly missed what is probably the single most significant and pervasive technological change of the last half-century: the ubiquity of tiny, powerful computers and everything they imply, from telecommuting to compact disc players, to CAT scans, to the internet, to interactive video games. (Don't get smug—so did almost the entire field of science fiction!)

Which is merely one example of how, contrary to Mr. Kaempffert's supposition, we can wander *very* far from reality if we confine ourselves to processes and inventions that are now being hatched in the laboratory. The real revolutions are likely to come from surprises—discoveries and inventions that *can't* be anticipated at the time of attempted prophecy. The microchip/computer revolution is perhaps the most conspicuous example of such a technological shift that has already had huge effects. The laser, on perhaps a smaller scale, is another. The aforementioned genetic engineering is just getting started, but promises to have at least equally sweeping consequences. Nanotechnolo-

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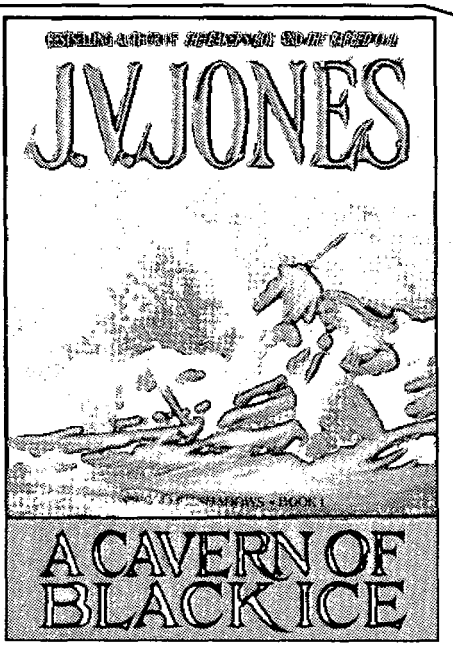

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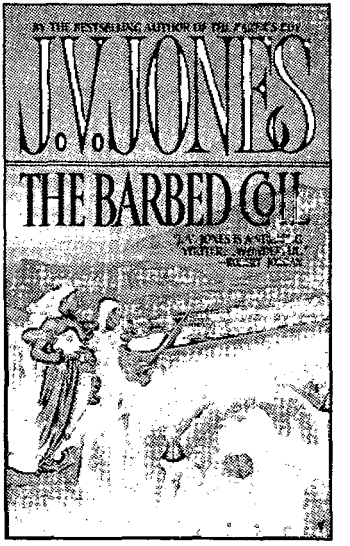

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gy is even younger, but likely to have even more far-reaching effects.

And, of course, some of the most important changes in any period are not technological, but social. There, too, the *Popular Mechanics* article had some conspicuous misses. It talks about "How Jane Dobson cleans house . . ." and "How Jane Dobson shops . . . ," and one picture caption reads, "Housewives in 50 years may wash dirty dishes right down the sink [their cheap plastic dissolving in hot water]." To us, today, that vision of dishwashing sets off alarm bells as a likely pollution source, unless the materials are very biodegradable. But what's likely to strike us as even stranger about this discussion is the implicit assumption that shopping and housecleaning and dishwashing are still the work of "housewives," while Joe Dobson is assumed to be the commuter.

The article's closing paragraph is particularly telling: "Any marked departure from what Joe Dobson and his fellow citizens wear and eat and how they amuse themselves will arouse comment. . . . It is astonishing how easily the great majority of us fall into step with our neighbors. And after all, is the standardization of life to be deplored if we can have a house like Joe Dobson's, a standardized helicopter, luxurious standardized household appointments, and food that was out of the reach of any Roman emperor?"

Well, some might not think so—but what has actually happened is far *less* standardization than prevailed in 1950. Indeed, a complaint not uncommonly heard today is that the market offers so many options—e.g., a dozen or more variations on "orange juice" within a single brand—that people sometimes feel overwhelmed by the number of choices they must make. And while there are certainly still pressures for conformity, particularly among the young, and many people seem to live their entire lives by bouncing from one fad to another, I think that there is also a good deal more variety in lifestyles and tolerance of our neighbors' eccentricities.

Both the unchanged roles of "housewives and breadwinners" and the assumption and acceptance of extreme standardization of life seem clear extrapolations of the way things were in 1950—an era now rather notorious for its homogeneity in those areas. The tacit assumption in this 1950 attempt to imagine the year 2000 seems to be, at least in the social sphere, "Just Like Now, But Even More So." It's probably almost inevitable that *any* prognosticator (present company not excepted) will tend to make such assumptions. The need to consciously try to avoid them is perhaps one of the first lessons to be drawn from this "look back at a look forward."

Another is: *expect surprises*. You *can't* imagine a truly likely future by simple extrapolation; there will almost certainly be important developments that cannot be anticipated by looking only at what's already known and in the works. A futurist working as such is at a disadvantage here; he or she can't postulate something out of the blue and seriously claim that it's likely to happen. A science fiction writer, on the other hand, can imagine anything that isn't demonstrably impossible, and then explore its likely consequences and ramifications—including changes in how people live. Many of those futures, of course, will bear little resemblance to what actually happens—but a few of them may well be more accurate than anything the "serious" forecasters can do.

And in trying to imagine those possible futures, it's essential to remember one more lesson illustrated by this little exercise: *you can't predict future trends by considering either technology or society in isolation*. They interact, and whenever you change one variable, you have to consider how it affects all the others. For a highly simplified example that we're already living, if computers become little, cheap,

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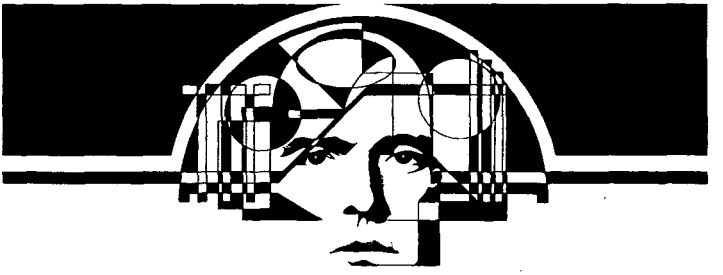
and easy to use, they're likely to become ubiquitous. If it becomes easy for them to talk to each other, e-mail becomes a prevalent mode of communication and it becomes possible for more and more people to work at least partly at home. So they do, and that influences the extent and nature of transportation. All of this effects fundamental changes in how people live and work and interact, and that in turn affects how receptive they will be to what new kinds of technology....

This type of integrated approach, considering technological and social change as a single highly interconnected system, is something this *Popular Mechanics* article didn't do very well. E.g., that automated factory it envisioned had only a few human employees, but the article also had lots of people (most of them male heads of households) commuting, many of them by private helicopter or huge "air buses" carrying hundreds of commuters. What were all these people commuting *to*? The article gives little hint of that. It shows pretty explicitly how many common jobs of 1950 had been eliminated by automation, but says essentially nothing about what the people who held those jobs were now doing instead. So the feeling in this article, as in too many science fiction stories, is of a future made of fascinating details that don't quite hang together into a logically consistent, believable whole.

Good science fiction writers, of course, know all this and appreciate the magnitude of the challenge. They will nonetheless continue trying—and sometimes making the same sorts of mistakes in spite of themselves. But amongst the mistakes, sometimes we'll get it right—and at the very least we'll have provided some advance scouting into just about any new territory that might come along.

So let's keep doing our best, and check back in another fifty years to see how well the current crop of "predictors" have done! ■



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Part One of Three

Catherine Asaro

THE QUANTUM ROSE

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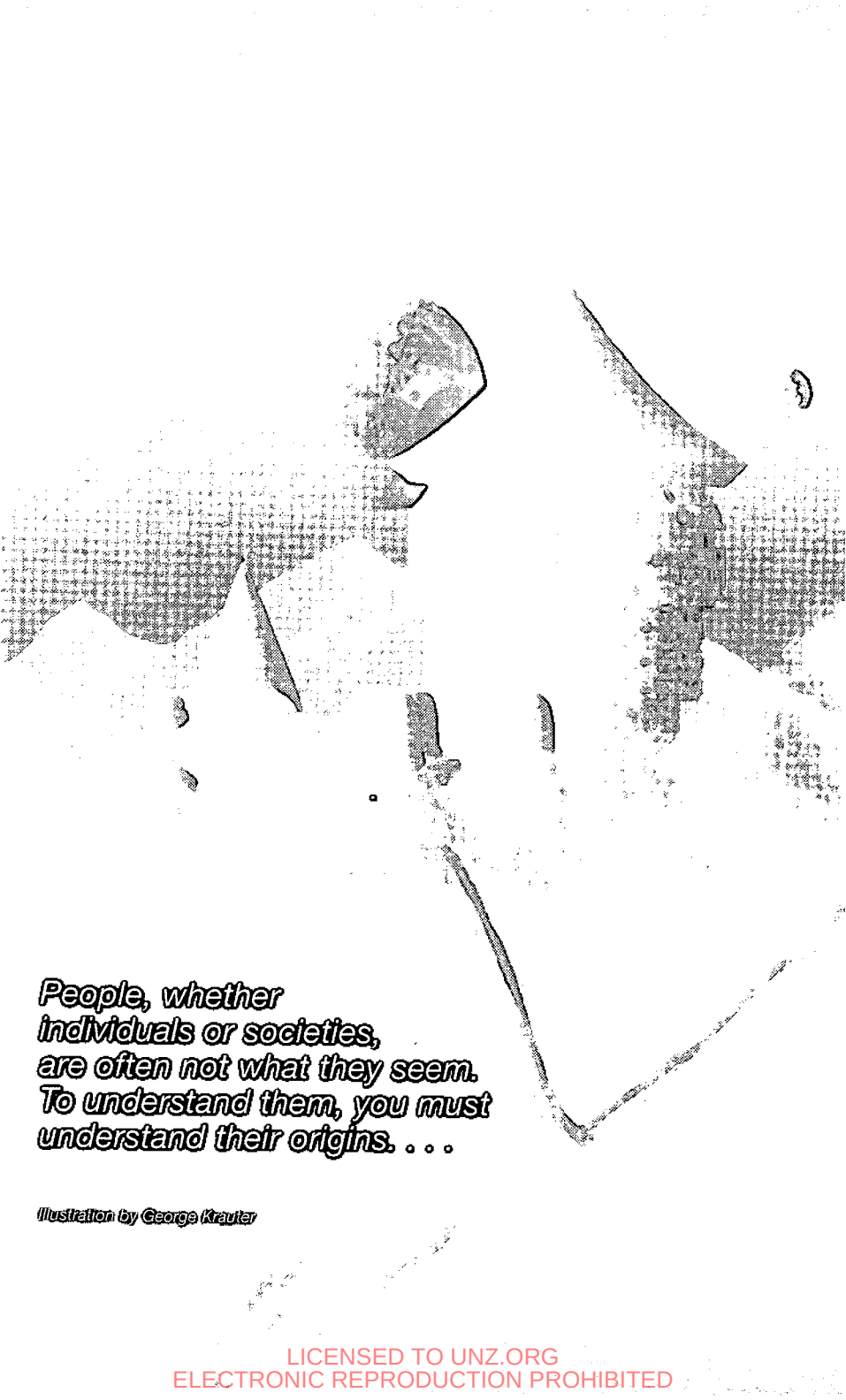
People, whether
individuals or societies,
are often not what they seem.
To understand them, you must
understand their origins. . . .

Illustration by George Krauter

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I

IRONBRIDGE

First Scattering Channel

Kamoj Quanta Argali, the governor of Argali Province, shot through the water and broke the surface of the river. She tilted her face up to the sky, a violet expanse punctured by Jul, the sun, a tiny disk of light so brilliant she didn't dare look near it. Curtains of green and gold light shimmered across the heavens in an aurora borealis visible even in the afternoon.

Her bodyguard Lyode was standing on the bank, surveying the area. Lyode's true name was a jumble of words from the ancient language Iotaca, what scholars pronounced as *light emitting diode.* No one knew what it meant, though, so they all called her Lyode.

Unease prickled Kamoj. She treaded water, her hair floating in swirls around her body, wrapping her slender waist and then letting go. Her reflection showed a young woman with black curls framing a heart-shaped face. She had dark eyes, as did most people in Argali, though hers were larger than usual, with long lashes that at the moment sparkled with drops of water.

Nothing seemed out of place. Reeds as red as pod-plums nodded on the bank, and six-legged lizards scuttled through them, glinting blue and green among the stalks. A few hundred paces behind Lyode, the prismatic forest began. Up the river, in the distant north, the peaks of the Rosequartz Mountains floated like clouds in a haze. She drifted around to face the other bank, but saw nothing amiss there either. Tubemoss covered the sloping hills in a turquoise carpet broken by stone outcroppings that gnarled out of the land like the knuckles of a buried giant.

Kamoj exhaled. What she felt wasn't unease exactly, more a sense of troubled anticipation. The afternoon hummed with life, golden and cool. Surely on this beautiful day she could relax.

Still, as much as she enjoyed swimming here, invigorated by the chill water and air, perhaps it was unwise. She had her position as governor to consider. Kamoj glided to the bank and clambered out, reeds slapping her body.

Her bodyguard glanced at her, then went back to scanning the area. Lyode suddenly stiffened, staring past Kamoj. Then she reached over her shoulder for the ballbow strapped to her back.

Surprised, Kamoj glanced back, across the river. A cluster of greenglass stags had appeared from behind a hill, each with a rider astride its long back. Sunrays splintered against the green scales that covered the stags. Each animal stood firm on its six legs, neither stamping nor pawing the air. With their iridescent antlers spread to either side of their heads, they shimmered in the blue-tinged sunshine.

Their riders were all watching her.

Mortified, Kamoj ran up the slope to where she had left her clothes. Lyode took a palm-sized marble ball out of a bag on her belt and set it in the sling on the targeting tube of her crossbow, which slid inside a accordion cylinder attached to the bow string. Drawing back the string and tube, she sighted on the watchers across the river.

Of course, here in the Argali, Lyode's presence was more an indication of Kamoj's rank, and her desire for privacy while she swam, rather than an expectation of danger. And indeed, none of the riders across the river drew his own bow. They looked more intrigued than anything else. One of the younger fellows grinned at Kamoj, his teeth flashing white in the streaming sunshine.

"This is embarrassing," Kamoj muttered. She stopped behind Lyode and picked up her clothes. Drawing her tunic over her head, she added, "Thashaverlyster."

"What?" Lyode said.

Kamoj pulled down the tunic, covering herself with soft gray cloth. Lyode was still standing in front of her, with

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her bow poised. Kamoj counted five riders across the river, all of them dressed in copper breeches and blue shirts, with belts edged by feathers from the blue-tailed quetzal.

One man sat a head taller than the rest. He wore a midnight-blue cloak with a hood that hid his face. His stag lifted its front two legs and pawed the air, its bi-hooves glinting like glass, though they were a hardier material, hornlike and durable. The man riding it gave no indication he noticed its restless motions. His cowled head remained turned in Kamoj's direction.

"That's Havyrl Lionstar," Kamoj repeated as she pulled on her leggings. "The tall man on the big greenglass."

"How do you know?" Lyode asked. "His face is covered."

"Who else is that big? Besides, those riders are wearing Lionstar colors." Kamoj watched the group set off again, cantering into the folds of the blue-green hills. "Hah! You scared them away."

"With five against one? I doubt it." Dryly, Lyode said, "More likely they left because the show is over."

Kamoj winced. She hoped her uncle didn't hear of this. As the only incorporated man in Argali, Maxard Argali had governed the province for Kamoj when she was young and was shifting his role to that of advisor now that she had reached her adulthood.

Lionstar's people were the only ones who might reveal her indiscretion, though, and they rarely came to the village. Lionstar had "rented" the Quartz Palace in the mountains for more than a hundred days now, and in that time no one she knew had seen his face. Why he wanted a ruined palace remained a mystery, given that he refused all visitors. When his emissaries had inquired about it, she and Maxard had been dismayed by the suggestion that they let a stranger take residence in the honored, albeit disintegrating, home of their ancestors.

However, no escape had existed from the "rent" Lionstar's people put forth. The law was clear: she and Maxard had to best his challenge or bow to his authority. Impoverished Argali could never match such an offer: shovels and awls forged from fine metals, stacks of dried firewood, golden bridle bells, dewhoney and molasses, dried rose-leeks, cobberwheat, tri-grains, and reedflour that poured through your fingers like powdered rubies.

So they yielded—and an incensed Maxard had demanded Lionstar pay a rent of that same worth every fifty days. It was a lien so outrageous, all Argali feared Lionstar would send his soldiers to "renegotiate."

Instead, he paid.

With Lyode at her side, Kamoj entered the forest. Walking among the trees, with tubemoss soft under her bare feet, made her more aware of her precarious position. Why had Lionstar come riding here today? Did their lands now also risk forfeiture to his wealth? She had invested his rent in machinery and tools for farms in Argali. As humiliating as it was to depend on a stranger, it was better than seeing her people starve. But she didn't think she could bear to lose any more to him, especially not this forest she so loved.

Drapes of moss hung on the trees and shadow-ferns attended their trunks. Far above, the branches formed a canopy that let only stray sunbeams reach the ground. Argali vines hung everywhere, heavy with the blush-pink roses that gave her home its name. Argali. It meant vine rose in Iotaca.

At least, most scholars translated it as rose. One insisted it meant resonance. He also claimed they mispronounced her middle name, *Quanta*, an Iotaca word with no known translation. The name *Kamoj* came from the Iotaca word for *bound*, so if this strange scholar was correct, her name meant *Bound Quantum Resonance.* She smiled at the absurdity. *Rose* made more sense, of course.

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Not all the "roses" in the forest were flowers, though. Camouflaged among the blossoms, puff lizards swelled out their red sacs. A shaft of sunlight slanted through the forest, admitted by a ruffling breeze, and sparkles glittered where the light hit the scaled lizards, the scale-bark on the trees, and the delicate scale-leaves. Then the ray vanished and the forest returned to its dusky violet shadows.

Suddenly a thornbat whizzed past her, its wings beating furiously. It homed in on a vine and stabbed its needled beak into the red sac of a puff lizard. As the puff deflated with a whoosh of air, the lizard scrambled away to safety, leaving the disgruntled thornbat to whiz on without its prey.

Powdered scales drifted across Kamoj's arm. She wiped off the shimmering dust, wondering why people had no scales. Most everything else on Balumil, the world, had them. Scaled needles fat with water nestled among the leaves, and roots swollen with moisture churned the soil. The trees grew slowly, storing water and converting it into energy as a bulwark against summer droughts and winter snows. Seasonal plants had other methods of survival. They lived only in spring and autumn, but their big, hard-scaled seeds could lie dormant for long periods, until the climate was to their liking.

If only people were as well adapted to survive. She swallowed, remembering the last winter, when nearly a fourth of Argali had died in its blizzards and brutal ices. Including her parents. Even after so long, that loss haunted her. She had been a small child when she and Maxard, her mother's brother, became sole heirs to the impoverished remains of a province that had once been proud.

Glancing at Lyode, Kamoj wondered if her bodyguard shared her concern about seeing Lionstar on Argali lands today. A tall woman with lean muscles, Lyode had the brown eyes and black hair common in Argali. Here in the shadows, the vertical slits of her pupils had widened until they almost filled her irises, like black pools. She carried Kamoj's boots dangling from her belt by their laces.

"Do you know the maize-girls that work in the kitchen?" Kamoj asked.

The older woman glanced at her. "Three children? Tall as your elbow?"

"That's right." Kamoj smiled. "They told me, in solemn voices, that Havyrl Lionstar came here in a cursed ship that the wind chased across the sky, and that he can never go home again because he's so loathsome the elements refuse to let him sail again." Her smile faded. "Where does all the superstition come from? Apparently most of Argali believes it. There is some story he's centuries old, with a metal face so ugly that if you look at it you'll have nightmares."

"I'm not sure." Lyode paused. "Legends often have their seeds in truth." With a dry smile, she added, "Though with the maize-girls, who knows? The last time I talked to them, they tried to convince me Argali is haunted. They think that's why all the light panels have gone dark."

Kamoj chuckled. "They told me that one too. They weren't too specific on who was haunting what, though." Legend claimed the Current had once lit all the houses in the Northern Lands. But that had been centuries past. In fact, in the North Sky Islands the Current had died thousands of years ago. The only reason one light panel still worked in Argali House, Kamoj's home, was because before Kamoj's birth, her parents had happened upon a few intact fiberoptic threads in the ruins of the Quartz Palace.

The threads were only one part in the panel, which used many components, all linked by cables and threads that extended into the walls of the house and to the few remaining sun-squares on the roof. No one understood anymore how any of it worked. Lyode's husband, Opter, had replaced the fiberoptics. Opter didn't know how the panel

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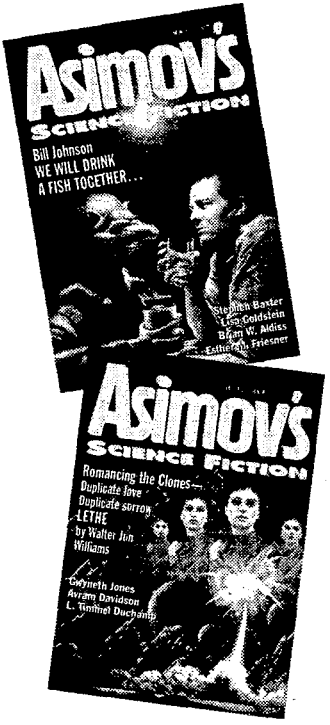

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worked either, nor could he fix damaged components. But given undamaged parts, he had an uncanny ability to figure out how they fit into gadgets.

"Hai!" Kamoj grimaced as a twig stabbed her foot. Lifting her leg, she saw a gouge between her toes welling with blood.

"A good reason to wear your shoes," Lyode observed.

"Pah," Kamoj muttered. She enjoyed walking barefoot, but it had its drawbacks.

A drumming that had been tugging at her awareness finally intruded enough to make her listen. "Those are greenglass stags."

Lyode tilted her head. "On the road to Argali."

"Come on. Let's look." Kamoj started to run, then hopped on her good foot and settled for a limping walk. When they reached the road, they hid behind the trees, listening to the riders.

"I'll bet it's Lionstar," Kamoj said.

"Too much noise for five riders," Lyode said.

Kamoj grinned. "Then it's fleeing bandits. We should nab them!"

"And just why," Lyode inquired, "would these nefarious types be fleeing up a road that goes straight to the house of the central authority in this province, hmmm?"

Kamoj laughed. "Stop being so sensible."

Lyode still didn't look concerned. But she slipped out a ball and readied her bow.

Down the road, the first stags came around a bend. Their riders made a splendid sight. The men wore gold disk mail, ceremonial, too soft for battle, designed to impress. Made from beaten disks, the vests were layered to create an airtight garment. They never attained that goal, of course. Why anyone would want airtight mail was a mystery to Kamoj, but tradition said to do it that way, so that was how they did it.

On rare occasions, a stagman also wore leggings and a hood of mail. Some ancient drawings even showed mail covering the entire body, including gauntlets and knee boots, with ball bearings in the joints to allow for ease of movement, and a transparent cover over the face. Kamoj thought the face cover must be artistic fancy. She saw no reason for it.

Her uncle's stagmen gleamed today. Under their mail vests, they wore bell-sleeved shirts as gold as suncorn. They also had gold breeches and dark red knee boots fringed by feathers from the green-tailed quetzal. Twists of red and gold ribbon braided their reins, and bridle bells chimed with the pounding motion of their greenglass stags. Sunlight slanted down on the road, drawing sparkles from the dusty air.

Lyode smiled. "Your uncle's retinue is a handsome sight."

Kamoj didn't answer. Normally she liked watching Maxard's honor guard, all the more so because she was fond of the riders, most of whom she had known all her life, just as she was fond of her uncle. Maxard's good-natured spirit made everyone love him, which was why a wealthy merchant woman from the North Sky Islands was courting him despite his small corporation. However, today Maxard wasn't with his honor guard. He had sent them to Ironbridge a few days ago, and now they returned with an esteemed guest, someone Kamoj had no desire to see.

The leading stagmen were riding past her hiding place now, the bi-hooves of their mounts whipping up scale dust from the road. She recognized the rider in front. Gallium Sunsmith. A big man with a friendly face, Gallium worked with his brother Opter in a sunshop, engineering gadgets that ran on light, like the mirror-driven peppermill Opter had invented. Gallium also made a good showing for himself each year in the swordplay exhibition at festival. So when Maxard needed an honor guard, Gallium became a stagman.

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Down the road, more of the party came into view. These new riders wore black mail, with purple shirts and breeches, and black boots fringed by silver feathers. Jax Ironbridge, the governor of Ironbridge Province, rode in their center. Long-legged and muscular, taller than the other stagmen, he had a handsome face with strong lines, chiseled like granite. Silver streaked his black hair. He sat astride Mistrider, a huge greenglass with a rack of cloud-tipped antlers and scales the color of the opal-mists that drifted in the high northern forests.

Still hidden, Kamoj turned away from the road and leaned against the tree with her arms crossed, staring into the forest while she waited for the riders to pass.

A horn sounded behind her, its call winging through the air. Startled, she spun around. Apparently she wasn't as well concealed as she had thought; Jax had stopped on the road and was watching her, the curved handle of a flighthorn in his hand.

Kamoj flushed, knowing she had given offense by hiding from him. Her merger with Jax had been planned for most of her life. He had the largest corporation in the northern provinces, which consisted of Argali, the North Sky Islands, and Ironbridge. Argument existed about the translation of the Iotaca word *corporation*: for lack of a better interpretation, most scholars assumed it meant a man's dowry, the property and wealth he brought into marriage. A corporation as big as Jax's became a political tool, invoking the same law of "Better the offer or yield" as had Lionstar's rent.

Ironbridge, however, had given Argali a choice. Jax made an offer Kamoj could have bettered. It would have meant borrowing every last bit of wealth owned by even the most impoverished Argali farmers, but besting the amount by one stalk of bi-wheat was all it took. Then she could have turned down the offer and repaid the loans. She had been tempted to try. But Argali was her responsibility, and her province desperately needed this merger with flourishing Ironbridge. So she had agreed.

Jax was watching her with an impassive gaze. He offered his hand. "It will be my pleasure to escort you back to Argali house."

"I thank you for you kind offer, Governor Ironbridge," she said. "But you needn't trouble yourself."

He gave her a cold smile. "I am pleased to see you as well, my love."

Hai! She hadn't meant to further the insult. Limping forward, she took his hand. He lifted her onto the stag with one arm, a feat of strength few other riders could have managed even with a child, let alone another adult. As he pulled her up, he turned her so she ended up sitting sideways on the greenglass, her hips fitted into the space in front of the first boneridge that curved over its back. Jax sat behind her, astride the stag, between its first and second boneridges.

The smell of his disk mail wafted over her, rich with oil and sweat. As he bent his head to hers, she drew back in reflex, before she could think. Although Jax showed no outward anger, a muscle in his cheek twitched. Taking her chin in his hand, he pulled her head forward and kissed her, pressing in on her jaw until he forced her mouth open for his tongue. When she tensed, he clenched his fist around her upper arm, holding her in place.

A rush of air thrummed past Kamoj, followed by the crack of a bowball hitting a tree and the shimmering sound of falling scales. Pulling away from her, Jax raised his head. Both the Argali and Ironbridge stagmen had drawn their bows and had their weapons trained on Lyode. Kamoj's bodyguard stood by the road, a second ball knocked in her bow, her weapon aimed at Jax.

All the stagmen looked uncomfortable, poised to return Lyode's fire, yet

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holding back. No one wanted to shoot Kamoj's bodyguard. The Argali stagmen had grown up with her and Gallium was her brother-in-law. The Ironbridge stagmen knew her as guardian of their governor's betrothed. However, neither could they ignore that she had just sent a bowball hurtling within a few hand spans of the two governors.

In a cold voice only Kamoj could hear, Jax said, "Your hospitality today continues to amaze me." Shifting his attention to Gallium Sunsmith, he spoke in a louder voice. "You. Escort Lyode back to Argali House."

Gallium answered carefully. "It is my honor to serve you, sir. But perhaps Governor Argali would also like to do her best by Ironbridge, by accompanying her bodyguard back."

Kamoj almost swore. She knew Lyode and Gallium meant well, and she valued their loyalty, but she wished they hadn't interfered. It would only earn them Jax's anger. She and Jax had to work this out. Although their merger was weighted in favor of Ironbridge, it gave control to neither party. They would share authority, she focused on Argali and he on Ironbridge. It benefited neither province if their governors couldn't get along.

She spoke to Jax in a gentle voice. "Please accept my apologies, Governor Ironbridge. I will discuss Lyode's behavior with her on the walk back. We'll straighten this out."

He reached down for her injured foot, bending her leg at the knee so he could inspect her wound. "Can you walk on this?"

"Yes." The position he was holding her leg in was more uncomfortable than the gouge itself.

"Very well." When he let go, his fingers inadvertently scraped the gash, and she stiffened as pain shot through her foot. She held her silence and slid off the stag, taking care to land on her other foot.

As she limped over to Lyode, bihooves scuffed behind her. Turning, she watched the riders thunder up the road to Argali.

Jul, the sun, had sunk behind the trees by the time Kamoj and Lyode walked around the last bend of the road, into view of Argali House. Legend claimed the house had once been luminescent pearl, all one surface without any seams. According to the temple scholar, who could read bits of the ancient codices, Argali House had been grown in a huge vat of liquid, on a framework of machines called *nanobots*, which were supposedly so tiny you couldn't see them even with a magnifying glass. After the house was complete, one was to believe the machines simply swam away and fell apart.

Kamoj smiled. The old scrolls were full of absurdities. Jax had shown her one in his library that claimed Balumil, the world, went around Jul in an "elliptical orbit" and rotated around a tilted axis. This tilt, and their living here in the north, was purported to explain why nights were short in summer and long in winter, fifty-five hours of darkness on the longest night of the winter, leaving only five hours of sunlight.

One year consisted of four seasons, of course: spring, summer, fall, winter. More formally, they called it the Long Year. A person could be born, reach maturity, wed, and have a family all within one Long Year. For some reason the scroll described this as a long time: hence the name. For an even more inexplicable reason, Kamoj's ancestors had partitioned the Long Year into twenty equal time periods they called short-years. So each season was five short-years in length. People rarely bothered to say "short-year," though. Instead, they used the word year to refer to the short-year and always used Long Year when they meant the time it took for all four seasons to pass.

Although Kamoj followed the conven-

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tion, it made no sense to her. Why call it a "short-year." It wasn't an actual year, after all. The scroll claimed this odd designation came about because a short-year on Balimul was close in length to a "standard" year.

Standard for *what?*

Still, it was more credible than too-little-to-see machines. Whatever the history of Argali House, it was wood and stone now, both the main building and the newer wings that rambled over the cleared land around it. Huge stacks of firewood stood along one side, stores for the winter. Bird-shaped lamps hung from the eaves, rocking in the breezes, their glass tinted in Argali colors, rose, gold, and green. Their radiance created a dam against the purple shadows that pooled under the trees. Here in the road, a fluted post stood like a sentinel, with a scalloped hook at its top. A lantern, molded and tinted like a rose, hung from the hook, its warm glow beckoning them home.

They walked along the low wall that enclosed the house and entered the courtyard by a gate engraved with vines. Five stone steps ran the length of the house, leading up to a terrace, and five doors were set at even intervals along the front. The center door was larger than the others, stuccoed white and bordered by hieroglyphs painted in luminous blue, as well as the usual Argali colors.

As they neared the house, Kamoj heard voices. By the time they reached the steps, it had resolved into two men arguing.

"That sounds like Ironbridge," Lyode said.

"Maxard too." Kamoj hesitated, her foot on the first step.

Above them, the door slammed open. Maxard stood framed in the archway, a burly man in old farm clothes. His garb startled Kamoj more than his sudden appearance. By now her uncle should have been decked out in ceremonial dress and mail, ready to greet the Ironbridge party. Yet he looked as if he hadn't even washed up since coming in from the fields.

He spoke in a low voice. "You better get in here."

She hurried up the steps. "What happened?" Had Jax been more offended than she realized?

Maxard didn't answer, just moved aside to let her into the entrance foyer, a small room paved with tiles glazed white and accented by Argali designs.

Boots clattered in the hall beyond. Then Jax swept into the foyer with five of his stagmen. He paused in mid-stride when he saw Kamoj. Then he went past her, over to Maxard, towering over the younger man.

"We aren't through with this, Argali," Jax said.

"My decision is made," Maxard answered.

"Then you are a fool." Jax glanced at Kamoj, his face stiff with an emotion she couldn't identify. Shock? He strode out the door with his stagmen, ignoring Lyode.

Kamoj turned to her uncle. "What's going on?"

He shook his head, his face impossible to read. Lyode came up the stairs, but when she tried to enter the house, Maxard stretched out his arm, putting his hand against the door frame to block her way. He spoke with uncharacteristic anger. "What blew into your brain, Lyode? Why did you have to *shoot* at him? Of all days I didn't need Jax Ironbridge angry, this was it."

"He was mistreating Kamoj," Lyode replied.

"So Gallium Sunsmith says." Maxard frowned at Kamoj. "What were you doing, running around the woods like a wild animal?"

Kamoj stared at him. She always walked in the woods after she finished working in the stables. Maxard often came with her, the two of them discussing various projects for Argali or just enjoying each other's company.

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Quietly she said, "Uncle, what is it? What's wrong?"

He blew out a gust of air. "Wait for me in the library."

She studied his face, trying to fathom what troubled him. No hints showed. So she nodded, to him and to Lyode. Then she limped into her house.

The centuries had warped the library door arch beyond simple repair. Kamoj leaned her weight into the door to shove it closed. Inside the library, shelves filled with codices and books covered the walls. The lamp by Maxard's favorite armchair shed light over a table there. A codex lay on the table, a parchment scroll made from the inner bark of a sunglass tree and painted with gesso, a smooth plaster. Glyphs covered it, delicate symbols inked in Argali colors. Kamoj could decipher none of the writing. But as she took responsibility for Argali, Maxard had more time for his scholarship. He was learning to read.

Behind her the door scraped open, and she turned to see her uncle. With no preamble, he said, "I've something to show you."

Puzzled, Kamoj accompanied him to an arched door in the far wall. The storeroom beyond had once held carpentry tools, but those were long gone, sold by her grandparents to purchase grain. Maxard fished a skeleton key out of his pocket and opened the tanglebirch door. Unexpectedly, oil lamps lit the room beyond. Kamoj stared past him—and gasped.

Urns, boxes, chests, gigantic pots, finely wrought buckets: they all crammed the storeroom full to overflowing. Gems filled baskets, heaped like fruits, spilling onto the floor, diamonds that split the light into rainbows, emeralds as brilliant as the eyes of a greenglass, rose-rubies the size of fists, sapphires, topazes, amethysts, cats-eyes, jade, turquoise. She walked forward, and her foot kicked an opal the size of a polestork egg. It rolled across the floor and hit a bar of metal.

Metal. *Metal.* Bars lay in tumbled piles: gold, silver, copper, bronze. Sheets of rolled platinum sat on cornucopias filled with fruits, flowers, and grains. Glazed pots brimmed with vegetables, and spice racks hung from the wall. Bracelets, anklets, and necklaces were everywhere, wrought from gold and studded with jewels. A chain of diamonds lay on a silver bowl heaped with eider plums. Just as valuable, dried foodstuffs filled cloth bags and woven baskets. Nor had she ever seen so many bolts of rich cloth in one place: glimsilks, brocades, rose-petal satins, gauzy scarves shot through with metallic threads, scale-velvets, plush and sparkling.

And light strings! At first Kamoj thought she mistook the clump thrown on a pile of crystal goblets. But it was real. She went over and picked up the bundle of threads. They sparkled in the lamplight, perfect, no damage at all. This one bundle was enough to repair broken Current threads throughout the village, and it was only one of several in the room.

Turning to Maxard, she spread out her arms, the threads clutched in one fist. "This is—it's—is this *ours?*"

He spoke in a cold voice. "Yes. It's ours."

"But Maxard, why do you look so dour!" A smile broke loose on her face. "This could support Argali for years! How did it happen?"

"You tell me." He came over to her. "Just what did he give you out there today?"

He? She blinked. "Who?"

"Havyrl Lionstar."

Hai! So Maxard had heard. "I didn't know he was watching."

"Watching *what?*"

"Me swimming."

"Then what?"

Baffled, she said, "Then nothing."

"Nothing?" Incredulity crackled in his voice. "What did you promise him,

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Kamoj? What sweet words did you whisper to compromise his honor?"

Kamoj couldn't imagine any woman having the temerity to try compromising the huge, brooding Lionstar. "What are you talking about?"

"You promised to marry him if he gave you what you wanted, didn't you?"

"*What?*"

Anger snapped in his voice. "Isn't that why he sent this dowry?"

Kamoj stared at him. "That's crazy."

"He must have liked whatever the two of you did."

"We did nothing. You know I would never jeopardize our alliance with Ironbridge."

Her uncle exhaled, his anger easing into puzzlement. "Then why did he send this dowry? Why does he insist on a merger with you tomorrow?"

Kamoj felt as if she had just stepped into a bizarre skit played out for revelers during a harvest festival. "He what?"

Maxard motioned at the storeroom. "His stagmen brought it today while I was tying up stalks in the tri-grain field. They spoke as if the arrangement were already made."

It suddenly became clear to Kamoj. All too clear. Lionstar didn't want the ruins of an old palace, or the trees in their forest.

He wanted Argali. All of it.

Strange though his methods were, they made a grim sort of sense. He had already demonstrated superiority in forces: many stagmen served him, over one hundred, far more than Maxard had, more even than Ironbridge. With his damnable "rent" he had taken the first step in establishing his wealth. He even laid symbolic claim to her province by living in the Quartz Palace, the ancestral Argali home. Any way they looked at it, he had set himself up as an authority to reckon with. Today he added the final, albeit unexpected, ingredient—a merger bid so far beyond the pale that the combined resources of all the Northern Lands could never best it.

"Gods," Kamoj said. "No wonder Jax is angry." She set down the light threads. "There must be some way I can refuse this."

"I've already asked the temple scholar," Maxard said. "And I've looked through the old codices myself. We've found nothing. You know the law. Better the offer or yield."

She frowned. "I'm not going to marry that insane person."

"Then he will be fully within his rights to take Argali by force. That was how it was done, Kamoj, in the time of the sky ships. Do you want a war with Lionstar?" Dryly he added, "I'm not sure my stagmen even know how to fight a war."

"There must be some way out."

He spoke carefully. "The merger could do well for Argali."

She stiffened. "You *want* me to go through with it?"

He spread his hands. "And what of survival, Governor?"

So. Maxard finally spoke aloud what they obliquely dealt with in every discussion about the province. Drought, famine, killing seasons, high infant mortality, failing machines no one understood, lost medical knowledge, and overused fields: it all added up to one inescapable fact, the long slow dying of Argali.

With the Ironbridge merger, their survival might still be a struggle, but their chances improved. At worst, Jax would annex her province, making it part of Ironbridge. She intended to do her best to keep Argali, and continue as its governor, but if she did lose it to Ironbridge, at least her people would have the protection and support of the strongest province on this continent. Although Jax didn't inspire love among his people, he was an intelligent governor who earned loyalty and respect.

And Lionstar? He might have wealth, but that didn't mean he was a good leader. For all she knew he would drive Argali into ruin, famine, and death.

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"Hai, Maxard." She exhaled. "I need time to consider this."

He touched her arm. "Go on upstairs. I'll send a maize-girl up to tend you."

"Lyode always tends to me."

"I need her elsewhere tonight."

She scowled. "You? Or Jax?" When he didn't answer, she swore. "I won't have my people flogged." She spun around to the door. "If you won't tell him, I will."

Maxard grabbed her arm, stopping her. Then he held up his other hand, a tiny space between his thumb and index finger. "Ironbridge is this close to declaring a rite of battle against us. I've barely thirty stagmen, Kamoj. He has over eighty, all of them better trained." He dropped his arms. "It would be a massacre. And you know Lyode. She would insist on fighting with them. Will you save Lyode and Gallium from a few lashes so they can die in battle?"

Kamoj swallowed. "Don't say that."

His voice quieted. "With the mood Ironbridge is in now, seeing you will only enrage him. He can't touch you, not yet, so Gallium and Lyode are the ones he will take his rage out on."

Kamoj gritted her teeth. Knowing Maxard was right made it no easier. She wondered, too, if her uncle realized what else he had just said. Not yet. Softly she asked, "And after the merger, when the rages take Ironbridge? Who will pay the price of his anger then?"

Maxard watched her with a strained expression, one that reminded her of the wrenching day he had come to tell her the bodies of her parents had been found, frozen beneath masses of ice in a late winter storm. She had never forgotten it.

He spoke now in the same aching voice. "Does it occur to you that you might be better off with Lionstar?"

She rubbed her arms as if she were cold. "What have I seen from Lionstar to make me think such a thing?"

"Hai, Kami." He started to reach for her, to offer comfort, but she shook her head. She loved him for his concern, but she feared to accept it, lest taking shelter from the pain would make it harder to face her responsibilities when that shelter was gone.

Maxard had caught her off guard with his insight into her relationship with Jax. Her uncle had always claimed he delayed her merger to give her experience at governing, lest Ironbridge be tempted to take advantage of a child bride. Now she wondered if it might have also been because Maxard had a better idea than he let on about the difficult life she faced with Jax. As an adult she had more emotional resources to deal with it.

But Maxard hadn't guessed the whole of it. Kamoj knew from her own experiences what would happen to Lyode and Gallium. The only difference was that in this case Jax would have one of his stagmen mete out the punishment rather than taking care of it himself, in private, with only Kamoj as witness—and recipient. She had never spoken of such incidents to Maxard, knowing that if he found out, he would have broken the betrothal no matter what price Argali paid. Kamoj couldn't let that happen. She would never set her personal situation over the survival of her people.

"Can you talk to Jax?" she asked. "Mollify him? Maybe you can keep him from hurting them."

"I will do what I can." He watched her with concern. "This will work out."

"Yes. It will." She wished she believed it.

After she left her uncle, she walked through the house, down halls paneled in tanglebirch, then up a staircase that swept to a balcony on the second floor. At the top of the stairs she looked out over the foyer below. The entrance to the living room arched in the right-hand wall, enough of the room visible so she could see a chandelier hanging from the ceiling like an inverted rose, flickering with candles. It reflected in the table beneath it, drawing gleams of green and blue from the polished tanglebirch.

Behind the table, a light panel glowed

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in the wall, the last working one in all the Northern Lands. When it failed, a thousand new light threads would do them no good. Even Opter Sunsmith couldn't fix a broken panel. The knowledge had been lost long ago, even from the Sunsmith line.

Kamoj turned and walked along the balcony to her room. She opened the door into a chamber warm with candlelight. It glowed on the parquetry floors, worn furniture, and her old doll collection on the table, her one concession to sentimentality. Her bed stood in one corner, each of its four posts a totem of rose blossoms and fruits, ending at the top with a closed bud.

A voice spoke behind her. "Ev'ning, ma'am."

She turned to see Ixima Ironbridge, a young woman with a smudge of flour on one cheek. Jax had sent the maize-girl to Argali last year, so Kamoj could get to know her. That way, when Kamoj went to Ironbridge she would bring a familiar face with her, someone who already knew the province. The thoughtful gesture had both touched and confused Kamoj. How could Jax be so considerate one moment and so harsh the next?

Ixima spoke in her heavy Ironbridge dialect. "Shall I be a'helpin' you change, ma'am?"

"Thank you." Kamoj sat on her bed. As Ixima knelt to take off her boot, Kamoj said, "Can you treat cuts?"

"I donnee know." Ixima slid off the boot and peeled away the sock. Kamoj winced as the cloth ripped away from her toes. Her foot must have bled during her walk and then dried her sock to her skin. Lifting her foot, she saw dirt ground into the gash.

"I should soak it in hot water," Kamoj said.

"I donnee see how a'rubbin' it would help," Ixima said. "You rest, hai, ma'am? Tomorrow it be feeling better enough to scrub."

Kamoj knew she should treat the cut now. But she was tired and had much to consider. Besides, she always healed well. Tomorrow she would tend to it.

After Kamoj was settled in bed, the maize girl darkened the room and left, leaving one candle flickering on the window sill. Kamoj lay on her back, her hands behind her head, staring at the ceiling. If she refused the Lionstar merger, it would placate Jax but break the law. If Argali and Ironbridge combined forces, they would have an army almost equal to that of Lionstar. But if Lionstar attacked, Kamoj would have to send people she loved into a rite of battle, including Maxard and Gallium. A good chance existed they wouldn't come home.

She knew what she had to do. As she made her decision, she felt a sense of lightening. She had no way to guess what Lionstar intended, but no matter what happened, never again would Jax raise his hand or quirt to her. Never again would he use the lives and well-being of her people as a weapon against her.

It was a bitter victory, given what she had seen of Lionstar, but it was all she had.

II

Lionstar

Second Scattering Channel

Kamoj squinted at the mirror while the threadwoman fussed over her. She heartily disliked formal clothes. Leggings and a farm tunic were more comfortable. But today was her wedding and at one's wedding one wore a wedding dress.

This dress had the weight of tradition behind it, not to mention the weight of impractical amounts of cloth. Her mother and grandmother had also worn it. Dyed the blush color of an Argali rose, it fit snug around her torso and fell to the floor in drapes of rose-scale satin. Handmade lace bordered the neckline and

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sleeves, and her hair fell in glossy black curls to her waist. The Argali Jewels glittered at her throat, wrists, and ankles, gold circlets designed like vines and inset with ruby roses. She hadn't expected ever to wear them. She had been on the verge of selling them, in fact, to buy grain threshers.

With tugs and taps, the aged threadwoman tightened the dress at the waist and tried to make it stretch to fit Kamoj's breasts. She cackled at her reluctant model, her eyes almost lost in their nest of lines. "You've no boy's shape, Gov'ner. You be making Lionstar a happy man, I reckon."

Kamoj glowered at her, but the seamstress was saved from her retort by a knock on the door. Kamoj limped across the room in her unfamiliar shoes, heeled slippers sheathed in rose scale-leather. She opened the door to see Lyode.

Her bodyguard beamed. "Hai, Kamoj! You look lovely."

"It's for my wedding," Kamoj said.

Lyode's smile faded. "Maxard told me."

Kamoj dismissed the seamstress, then drew Lyode over to sit with her on the couch. The older woman started to lean against the back of the sofa, but jerked when her shoulders touched the cushions and sat forward again.

Watching her, Kamoj said, "You've huge bags under your eyes."

"I had—a little trouble sleeping last night."

Kamoj wasn't fooled. But Maxard must have mollified Jax to some extent; otherwise Lyode wouldn't have been able to move at all.

"How is Gallium?" she asked.

Gently Lyode said, "He's all right, Kami. We both are."

Kamoj crumpled her skirt in her fists. "I hate all this."

"Hate is a strong word. Give Lionstar a chance."

"Lyode—"

"Yes?"

"About tonight . . ." Although in theory Kamoj knew what happened on a wedding night, it was only as vague concepts. But she felt awkward asking advice on such matters even from Lyode.

"Don't look so dour." Lyode's face relaxed into the affectionate grin she took on at the mention of her own husband, Opter. "Weddings are good things."

Kamoj snorted. "You look like a besotted fruitwing." When her bodyguard laughed, Kamoj couldn't help but smile. "How will I know what to do?"

"Trust your instincts."

"My instincts tell me to run the other way."

Lyode touched her arm. "Don't judge Lionstar yet. Wait and see."

At sunset the Argali coach rolled into the courtyard, pulled by four greenglass stags and driven by a stagman. Shaped and tinted like a rose, it sat in a chassis of emerald-green leaves. Unlike Argali House, which had only legends attesting to its construction, the coach was inarguably one surface with no seams, glimmering like pearl. Its making was so long in the past, no one remembered how it had been done.

Watching from her bedroom window, Kamoj heard the door behind her open. She turned to see Lyode framed in the archway, the bodyguard dressed in her finest shirt and trousers, with her bow on her back.

"It's time to go," Lyode said.

Kamoj crossed the room without a limp. She felt nothing in her foot now: it had gone numb. She had soaked and cleaned the wound this morning, but it remained swollen. Normally she would have paid more attention, but she had too much else to think of now.

Maxard was waiting at the bottom of the stairs. She smiled to see him. Today no lack of splendor would shame Argali. Her uncle's mail vest gleamed, a gold contrast to his black hair and eyes. He wore a suncorn shirt, wine-red suede breeches, and a belt made from green, gold, and red quetzal feathers. Green

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feathers lined the tops of his gold knee-boots, and a ceremonial sword hung at his side, its scabbard tooled with Argali designs.

As Kamoj descended the stairs, her uncle watched with a smile that showed both pride and sorrow. When she reached him, he said, "You look like a dream." His voice caught. "Just yesterday you were a child. When did all this happen?"

"Hai, Maxard." She hugged him. "I don't know." It was true. She had been a child; now she was an adult. Nothing separated the two. It gave her an inexplicable sense of loss. Why? Why should she want more time as a child?

She knew the stories, of course, of the rare child who took longer to reach adulthood. Rumor claimed Jax Ironbridge's youth had stretched out far longer than normal. At her age he had still been an adolescent, tall and gangly, with only the first signs of his beard. He continued to grow long past the age when most youths reached maturity. He came into full adulthood well after most men his age—and by that time he was taller, stronger, and smarter than everyone else.

With Maxard and Lyode on either side, Kamoj left the house. A group of her friends had gathered in the courtyard, young women with rose vines braided into their black hair. They waved and smiled, and Kamoj waved back, trying to appear in good spirits.

Gathered around the coach, ten stagmen sat astride their mounts, including Gallium Sunsmith. A smudgebug flittered into the face of one stag and the animal pranced to the side, crowding Gallium's greenglass. As the rider of the first animal pulled back his mount, his elbow accidentally bumped Gallium's back. Kamoj saw the grimace of pain Gallium tried to hide, just as Lyode had done when she sat back on the couch.

Kamoj's smile faded, lost to dismal thoughts of Jax. As she passed Gallium, she looked up and spoke softly. "My gratitude, Goodman Sunsmith. For everything."

He nodded, his face gentling. Lyode opened the coach door, and Maxard entered first, followed by Kamoj. Lyode came last and closed the door, shutting them into the heart of a rose. The driver blew on his flight horn, and its call rang through the evening air. Then they started off, bumping down the road.

The three of them sat in silence, at a loss for words. The coach rolled slowly, so the people walking could keep up with it. Even so, it seemed to Kamoj almost no time passed at all before it came to a stop.

The door swung open, framing Gallium in its opening. Beyond him in the gathering dusk, the golden face of the Spectral Temple basked in rays of the setting sun. Kamoj's retinue of stagmen and friends, and now many other villagers too, stood waiting in the muddy plaza before it.

Lyode left the coach first. Kamoj gathered up her skirts and followed, but in the doorway she froze. Across the mud and cobblestones, a larger coach was rolling into view. Made from bronze and black metal, it had the shape of a roaring skylion's head with wind whipping back its feathered mane. Every burnished detail gleamed. The eyes were emeralds as large as fists. Kamoj wondered where Lionstar found such big gems. Argali's jewel-master had checked and double-checked the ones in his dowry. They were real. Flawless and real.

As soon as the coach stopped, its door opened. Two stagmen came out, decked out in copper and dark blue, with cobalt diskmail that glittered in the sun's slanting rays. Sapphires lined the tops of their boots.

Then a cowled man stepped down into the plaza.

Kamoj shuddered. Lionstar towered over everyone else, easily the largest man in the courtyard. As always, he wore a blue cloak with a cowl pulled up over his head. Only black showed inside

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that shadowed hood; either he had a cloth over his face—or he had no face.

Maxard took her arm. "We should go."

His touch startled her into motion. She descended from the coach, onto a flagstone that glinted with mica even in the purple shadows. Her heels clicked as she crossed the courtyard, stepping from stone to stone to avoid the mud.

The Spectral Temple, also called the Special Functions House, was a terraced pyramid with a staircase climbing its left side. Rays from the setting sun hit the stairs at just the right angle to make a snake of light curve down them to the statue of a starlizard's head at the bottom, creating a serpent of radiance and stone.

On the front face of the temple, a huge starlizard's head opened its mouth in a roar, forming an entrance. Its front four legs stretched out on the ground, its back legs were braced against the slanting wall, and its tail coiled around the base of the pyramid. As Kamoj watched, a sunray hit the lizard's crystal eyes and arcs of light appeared on either side of its head, an effect created by the temple's ancient architect to mimic the Perihelia spirits, sometimes called Sun Lizards or Jul Lizards, that guarded the temple.

True sun lizards appeared in the sky as partial halos of light on either side of the sun, like pale rainbows, with a long serpent's tail of white light extending out from them. Their favored time was near dusk, as the bright, tiny Jul descended to the horizon, scantily dressed in wispy clouds, while the sky overhead darkened to a deep, deep violet. During winter, when ice crystals filled the air, Perihelia and Halo spirits graced the heavens in arcs and rings, and even appeared around the head of a favored person's shadow when it lay across a dew-covered expanse of tubemoss at dawn.

Lionstar's group reached the Jul Lizard first. He stopped under the overhang of its fanged mouth and waited, his cowled head turned toward Kamoj. She came up with her retinue and they stopped. After they had all stood that way for several moments, she flushed, wondering what Lionstar wanted. Didn't he know he should go in first?

One of Lionstar's stagmen spoke to him in a low voice. He nodded, then turned and entered the temple with his retinue. Relieved, Kamoj followed with her own people. No one spoke. She wondered if Lionstar could even talk. No one she knew had ever heard him do it.

Inside, sunset light trickled through slits high in the walls. Stone benches filled the interior, except for a dais at the far end, where a polished stone table stood. Decorating the table were carvings of Argali vine designs, those motifs known as *Bessel integrals* in ancient Iotaca. Genuine rose vines and ferns heaped the table, filling the air with fragrance, fresh and clean.

Around the walls, more garlands hung from statues of several Current spirits—the Airy Rainbows, the Glories, and the Nimbi. In the wall slits above the statues, light slanted through faceted windows with water misted between the double panes, creating spectral arcs of color. Music graced the air, from breezes blowing through fluted chambers on the ceiling, hidden within bas relief depictions of the Spherical Harmonic wraiths. Today it all seemed unreal.

As the retinues and villagers sat on the benches, Kamoj walked to the far end of the temple with Maxard at her side and Lionstar preceding them. The priestess, Airysphere Prism, waited by the flower-bedecked table. Taller than average, Airys had dark eyes and glossy black hair that fell to her waist.

When Lionstar reached Airys, he turned to watch Kamoj. At least she assumed he was watching. His cowl hid his face. Even when she reached him, she saw only darkness within that hood, perhaps a glint of metal.

Maxard bowed to him. "Argali welcomes you, Governor Lionstar."

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Lionstar nodded. After an awkward silence, Maxard flushed, though whether from anger or shame at the implied insult in that silence, Kamoj didn't know.

Finally her uncle took her hands. "May the Current always flow for you, Kami."

She squeezed his fingers. "And you, dear Uncle."

Maxard swallowed. Then he let her go and left the dais, going to sit on the front bench with Lyode.

"It is done?" Lionstar asked.

Kamoj almost jumped. His voice was deep and resonant, with a heavy accent. On the word "is," it vibrated like a stringed instrument.

Airys blinked, the vertical slits of her pupils opening wide in the shadowed temple. With her large eyes and delicate features she looked almost ethereal herself. "Do you refer to the ceremony?" she asked.

"Yes," Lionstar said.

"It hasn't begun." She took a scroll from the table and unrolled it. Glyphs covered the parchment in starlight blue ink and Argali colors. She offered it to Lionstar, and he took it with black-gloved hands.

"Governor Argali," Airys said. "Give me your hand."

After Kamoj extended her arm, Airys took it and said, "In the name of Spectra Luminous I give this man to you." She turned. "Havyrl Lionstar, give me your hand." When he complied, Airys took a vine from the altar and tied his and Kamoj's wrists together, bedecking them in roses and scale-leaves. Looking up at Lionstar, she said, "You may read the contract now."

Kamoj waited for him to decline. No one ever actually read the contract. Only scholars knew how to read, after all, and only the most gifted knew ancient Iotaca. Most people considered the scroll a fertility prayer. Kamoj had her doubts; Airys had managed to translate a few parts of it for her, and to Kamoj it sounded more like a legal document than a poem. She supposed lovers preferred to see matters in terms of moons and fertility, though.

In any case, the groom always returned the scroll. Then the wedding couple spoke a blessing they had composed themselves. Kamoj hadn't written anything and she doubted Lionstar had either, so they would simply go on with the ceremony.

Except they didn't. Lionstar read the scroll.

As his voice rumbled, indrawn breaths came from their audience. Kamoj doubted anyone in Argali had ever heard the blessing spoken at a merger, let alone with such power. Lionstar had a deep voice, with an unfamiliar accent and the burr of a vibrato. It also sounded slurred.

When he finished, the only sounds in the temple were the faint calls of evening birds outside.

Finally he said, "This ceremony, is it done?"

Airys managed to recover. "The vows are finished, if that is what you mean."

He gave her the scroll. Then he untied the vine joining his and Kamoj's wrists and draped it around Kamoj's neck so the roses spilled over her breasts. She stiffened, jarred by the break with tradition; they weren't supposed to undo the vine until they consummated the marriage. Before she had a chance to speak, he took her elbow, turned her around, and headed for the entrance, bringing her with him.

Murmurs came from the watchers, a rustle of clothes, the clink of diskmail. Belatedly Kamoj realized he had misunderstood: he thought the ceremony was over when it had hardly begun. But the rest was only ritual. The vows were said. Argali and Lionstar had their corporate merger.

They came out into a purple evening. It happened so fast Kamoj barely had time to catch her breath before they reached Lionstar's coach. Lionstar stopped, looking at something over her

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head, and she turned to see Maxard coming up to them, flanked by Lyode and Gallium.

Lionstar spoke to her uncle. "Good night, sir."

Kamoj wondered what he meant. Was "good night" a greeting or a farewell?

Maxard bowed to him. Lionstar nodded, then motioned to his men. As he raised his arm, his cloak parted and revealed his diskmail, a sapphire flash of blue. What metal he did use, to create such a dramatic color? One of his stagmen opened the coach door, and Lionstar put his hand on Kamoj's arm, with the obvious intent of passing her into the coach.

It was happening too fast. Kamoj balked, turning from Lionstar, and went over to Lyode. As she and Kamoj embraced, Lyode murmured, "You're like a daughter to me. You remember that. I will always love you." Her words had the sound of tears.

Kamoj's voice caught, muffled against her shoulder. "And I you."

Stepping back, Kamoj turned to Maxard. But before she had a chance to bid him farewell, Lionstar took her elbow and drew her toward the coach. She almost pulled away again, but hesitated. Antagonizing the man who had just taken over Argali would be a poor start to their merger. She gave Maxard a farewell glance and he nodded, his and her eyes both wet with unshed tears.

Then Lionstar passed her to one of his stagmen, who handed her up into the roaring lion. Its interior was somber, panelled in black moonglass wood and upholstered in dark leather. A window showed in the wall by her seat. Turning to watch Lionstar enter, she saw another window in the door behind him. Yet from outside, no windows had shown at all.

As a stagman closed the door, Lionstar sat next to her, his long legs filling the car. His cloak fell open, revealing ceremonial dress much like Maxard's, except in darker colors. The coach rolled forward, and Kamoj looked out the window, to catch a final glimpse of her home. But the "glass" was fading into a blank expanse of wood. Alarmed, she turned to look out Lionstar's window, only to find it had gone away as well.

With such a dark interior and no lamps, it should have been pitch black in the coach. But light still filled it. She bit her lip, wondering where the luminance came from.

"Here." Lionstar tapped the ceiling. His voice had a blurred quality to it.

Puzzled, she looked up. A glowing white strip bordered the roof of the coach. It resembled a light panel, but made as thin as a finger and flexible enough to bend.

"That's what you were looking for, wasn't it?" he said. "The light?"

How had he known? "Yes."

He nodded, then reached into his cloak and brought out a bottle. Shaped like a curved square, it was made from dark blue glass with a gold top. He unscrewed the top, lifted the bottle into his cowl, and tilted back his head. After a moment he lowered the bottle and wiped his hand across whatever he had for a face. Then he returned the bottle to his cloak.

Kamoj blinked, catching a whiff of rum. Then Lionstar turned and slid his arms around her. With one black-gloved hand, he rubbed the lace on her sleeve, rolling it between his fingers. Then he folded his hand around her breast, under the vine of roses, and pressed his lips against the top of her head while he caressed her.

Embarrassed and flustered, Kamoj sat utterly still. But his hand soon stopped moving. In fact, after a few moments, it slipped off her breast and fell into her lap. His whole body was leaning on her now, making it hard to sit up straight. She squinted up at him, wondering what to do. While she pondered, he gave a snore.

Her new husband, it seemed, had gone to sleep.

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She gave him a nudge. When he made no objection, she pushed him into an upright position. He lay his head back against the seat, his mail-covered chest rising and falling in a deep, even rhythm. Just as she started to feel grateful for this unexpected reprieve to absorb her situation, he tried to lie down again. The coach didn't have enough room for his legs, so he stretched out on the seat with his feet on the ground and his head in her lap. Then he went back to snoring.

Kamoj scratched her chin. Of all the possible scenarios she had imagined for their ride to the palace, this wasn't one of them. She stared at his cowled head in her lap, the hood lying across his face. Was he truly as hideous as everyone claimed?

For a while she resisted her curiosity. The longer he slept, though, the more the thought nagged at her. How would he even know if she looked?

Finally she could take it no more. She tugged on his cowl. When he made no protest and showed no sign of waking, she pulled more. Still no response from Lionstar. Emboldened, she brushed the hood back from his head—and nearly screamed.

He had no face.

No eyes, no nose, no mouth. Just metal. His head was man-shaped, with the contours of a face, but instead of skin and human features, he had only silver scales.

"Hai," she whispered. She drew in a shakey breath. So. Now she knew.

As her pulse calmed, she took in more of his appearance. He had human hair. No, not human. It too had a metallic cast. Thick glossy curls spilled to his shoulders, a mixture of gold, bronze, and copper, with silver at the temples. It was glorious. She had never seen those colors, though. Some farmers in Ironbridge had yellow hair, but nothing like this multi-hued mane.

In fact, it fit his name almost too well. A remarkable coincidence, that someone named Lionstar happened to have such a leonine mane, like the skylions of the upper mountains, with their six-legged scaled bodies and feathered manes. Then again, maybe his ancestors adopted the name because such hair ran in his line. People had done stranger. She was named for a plant, after all, and the Current only knew what Quanta meant.

Kamoj brushed a finger over his curls. He kept on sleeping. At least she thought he was sleeping. How did one tell when a person had no eyes? In any case, he gave no evidence he disliked her touch. She slid her hand deeper into his curls. Hai. They felt as good as they looked.

As she stroked his hair, her fingertips scraped his face. The metal felt smooth under her skin. She ran her finger down to his jaw and pushed the scales.

His face slipped.

Kamoj jerked away her hand. When he still showed no sign of waking, she leaned over and peered at the metal. It had indeed moved. She pushed it again—and it crumpled, uncovering a stretch of skin.

A mask. He was wearing a *mask*. She almost laughed in her relief. She hadn't married a man with no face after all.

Sliding her finger along the mask, she peeled it away from his head. It came off like a flexible skin, revealing a face that was unusual, but human. He was nowhere near as old as rumor claimed, only about forty, perhaps a bit more. His features were handsome, with high cheekbones and a straight nose. His lashes lay long against his cheeks, in a lush gold fringe, real metal, soft enough so they probably didn't irritate his eyes, but still unlike human hair. His skin had a gold tinge. When she touched his face, though, the skin felt warm. Human. His lips were full. Sensual. She ran her finger along the lower one and it yielded under her touch.

His breathing sounded strained, and dark circles of fatigue showed under his

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eyes. She also smelled the rum more. The mask had helped hide the odor on his breath before, but now it filled the coach, mixing with the scent of the scale dust.

As his breathing grew more labored, Kamoj became alarmed. She spread the mask back over his face, but no matter how she placed it against his skin, she couldn't get it to stay.

Suddenly he moved, rolling onto his back to look up at her. He croaked words in a language she didn't understand and clawed at the mask. Dismayed, she pushed it into his hand. Before he could put it on, his entire body went rigid and he began to choke, his fingers clenched around the crumpled metal skin.

A siren pierced the air, coming from nowhere Kamoj could see. Frantic now, she pried the mask out of his fist and pressed it against his face again. Still it wouldn't stay.

The coach lurched to a stop so fast it threw both she and Lionstar onto the floor. The door slammed open and two stagmen jumped inside. One pulled Kamoj back out of the way while the other knelt by Lionstar. The second stagman had another mask in his hand, this one firmer, and translucent, with a tube connected to a metal cylinder. He set the mask over Lionstar's face and a hissing noise filled the coach.

Kamoj tried to pull away from the stagman holding her, but he wouldn't let go. She looked up and saw him staring at the mask she held. Then he called her a name, one she had never thought anyone would say to her. A stagmen behind them opened his mouth to chastise the man who insulted her. Then he saw the mask she held and whatever he had meant to say died on his lips.

A groan came from the floor. Turning back, she saw Lionstar breathing from the new mask. The stagman gripping her arm relaxed, though not enough to let her pull away.

Lionstar sat up, holding the mask in place. When his man tried to offer assistance, the governor shook his head. So the stagman withdrew, stepping out of the coach. Lionstar stood up, one hand braced against the wall, bending his head so it didn't hit the roof.

He moved his mask aside and spoke to the man holding Kamoj. "Let her go, Azander."

"Sir, she took your breathing skin off," Azander said.

Lionstar waved the mask. "Curiosity's nay murder. Go'n. Drive us home."

"Yes, sir." As Azander backed out of the coach, he gave Kamoj a hard look. She recognized the warning. If she hurt Lionstar, Azander would see that she paid for it.

Within moments they were rumbling along the road again. Seated next to Kamoj, Lionstar leaned back and closed his eyes, holding the new mask over his face, with the metal cylinder at his side. She wondered if he really believed she had taken off his other mask out of curiosity, or if he suspected what Azander almost said, that his new bride had tried to murder him.

Sitting up again, Lionstar took out his bottle and fumbled with it, trying to open it one-handed. Finally he dropped the mask in his lap and used both hands to open the bottle. He drank deeply from it, his throat working as he swallowed.

When he finished, he handed Kamoj the empty bottle. "Put top back'n." Then he put his mask over his face again, holding it with one hand.

Kamoj replaced the top, wondering if he always drank this much. Maybe that was why he didn't care that he lived in the ruins of a palace.

The new mask covered only his mouth and nose, giving her a view of his eyes. They were large, and a remarkable color, dark violet. Red and violet, actually; they would have been beautiful if they hadn't been so bloodshot. Even stranger, though, were the pupils. Rather than vertical slits, his were

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round. Although odd, the effect wasn't unpleasant. In fact, it had a sense of "rightness" that puzzled Kamoj, an inexplicable familiarity.

Right now those unusual eyes were watching her. Lionstar pulled aside his mask. "Why'd do it?"

She knew what he meant. "I wondered what you looked like."

"You could have just asked."

"I'm sorry. I didn't know it would hurt you."

He nodded. Then he lay his head back and closed his eyes. After a moment the mask fell out of his hand and into his lap.

"Governor Lionstar." Kamoj shook his shoulder. "Your breathing skin." When he opened his eyes, blinking at her, she gave him the silver mask. He tried pressing it into place, with no more success than she had managed earlier. He squinted at it, then flipped the metal skin over and tried again. This time it stayed in place, leaving his face a smooth sheen of silver, with black ovals for eyes.

"'S better," he mumbled. He laid his head back and the ovals closed, taking away that last vestige of humanity.

III
Pacal
Scattering Kernel

They rode for an hour, Lionstar sleeping while Kamoj sat in bored silence. Finally the coach rolled to a stop. Azander opened the door and took in the scene, Lionstar dozing, Kamoj holding the empty bottle. The stagman didn't look surprised.

Leaning inside the coach, Azander shook Lionstar's shoulder. "Prince Havyrl. We be home."

Kamoj blinked at the archaic title. Prince? Of *what?*

Lionstar's eyes opened, black on silver. "What?"

"Home," Azander repeated. "You and your bride."

"Bride?"

"Yes, sir. Your bride."

"What bride?"

Azander tilted his head toward Kamoj. "The Governor of Argali."

"Oh. Yes. Of course." Lionstar sat up, rubbing his hand through his hair. "See to the stags."

"Yes, sir." Azander backed out of the coach.

Lionstar followed him out into the night, which was lit by a faint radiance. As Kamoj stepped down from the coach, he offered his hand. Taking it, she thought she felt callouses under his glove. That made no sense, though. A man of his power would hardly have the callouses of a farmer.

Then she turned around—and froze in astonishment.

They were in the courtyard of the Quartz Palace. Gone were the crumbled ruins covered by tangled vines, briars, and roses. Now the rose-quartz palace gleamed, restored to its full beauty and more. Long and narrow, with a terrace that stretched its length, it had nine evenly spaced entrances. A tower reached up at each end, topped by red turrets. Bird-shaped lamps hung in the windows and from the eaves, making the walls glow. Above it all, the aurora borealis shimmered in the sky, curtains of gold and pink luminance undulating across the heavens.

"Sweet Airys," Kamoj whispered. "It's lovely."

"S'pretty," Lionstar agreed.

He took her elbow and led her toward the steps that went up to the terrace. The double doors in the center swung open and more radiance spilled into the night, backlighting three people. She recognized two as villagers from Argali, a man and woman, each of normal height, both dressed in servant's clothes.

The third person came out to meet them. Tall and gaunt, with a craggy face and short graying hair, the woman was like no one Kamoj had ever before seen.

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She wore a form-fitting gray suit made in one piece, with gray knee-boots. A patch on her shoulder showed an exploding star within a triangle.

She met them half-way down the steps. Lionstar nodded to her, and they all walked up the stairs together. Although the woman looked hale and fit, her breathing was growing labored, as if she had just run a race instead of walking only a few steps.

At the top of the stairs, Kamoj froze. A few paces away, a shimmer of light hung in the open doorway.

"'S even nicer inside," Lionstar said, mistaking her hesitation.

No one else seemed bothered by the curtain of light, and Kamoj didn't want to look foolish. So she took a breath and walked with them through the shimmer. It clung to her like a soap bubble, sliding over her face, hair, and clothes.

The entrance foyer looked as she recalled, a small room with tiles on the floor enameled in Argali rose designs. Except now the tiles were whole and the walls smooth, each brick snug with its neighbors, none showing their former chinks and cracks.

Lionstar peeled off his mask and Kamoj tensed, afraid he would choke again. But no one else acted alarmed. In fact, she had never tasted such pure, rich air. It made her dizzy, almost euphoric.

The tall woman was breathing normally now. She asked Kamoj a question, but Kamoj had trouble with her heavy accent. The woman was speaking Bridge, Kamoj's language, but she used the same odd dialect as Lionstar. Like Lionstar, she also mixed in words from Iotaca.

The woman tried again. "Are you all right, Governor Argali?"

Kamoj stood up straighter, trying not to feel intimidated by the woman's unusual height. "Yes."

"She's fine." Lionstar waved his arm at the two Argali servants. "Jus' like them. Fine."

The woman glanced at him, then at the bottle Kamoj still held. She spoke to Lionstar in another language, her voice tense. Lionstar answered with a scowl, then turned away and took Kamoj's arm. He led her to an archway across the foyer, where another shimmer curtain hung. Kamoj held her breath as they walked through it, but nothing untoward happened.

The air in the Entrance Hall, on the other side, felt as pure as in the foyer. New panels of mellow sunglass wood covered the walls. She had never before seen the paintings Lionstar's people had hung here, scenes of the Argali countryside. He must have commissioned them from the villagers, which meant he was supporting the Argali economy.

Then she saw the other additions to the hall. Light panels—light panels!—glowed near the ceiling.

Lionstar was watching her face. "'S good, yes?"

"Yes." She had never expected this generosity. He didn't even own this building he had refurbished. Then it occurred to her that perhaps it wasn't such generosity after all. He did own the palace now, as well as everything else that had belonged to her family. Including her.

They walked down the Entrance Hall, accompanied by the two servants and the tall woman. The hall ended at a gleaming ballroom that stretched to their right and left. Radiance from its chandeliers reflected off the walls and parquetry floor, yet she saw no candles within the chandeliers, only shimmers of light.

They crossed the width of the ballroom to another archway that opened into the Long Hall, which ran the length of the palace perpendicular to the Entrance Hall. Moonglass paneled its walls and a dark carpet covered the floor. Lamps set in rose-shaped molds glowed at intervals along the walls.

Lionstar set off down the hall, still holding Kamoj's arm. The tall woman

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easily matched his stride, but Kamoj and the servants almost had to run to keep up.

Lionstar didn't stop until they reached a door at the east end. Then he turned to the others. "You can go. I'll take her up."

The tall woman spoke. "Perhaps Kamoj would like to meet the staff. Look at the palace. Have dinner." Dryly she said, "Catch her breath."

"Who?" Lionstar asked.

"Kamoj," the woman said.

"Who's that?" he asked.

This isn't happening, Kamoj thought.

The woman stared at him. "Your *wife*."

Lionstar turned to her. "Kamoj? Is that your name?"

"Yes," Kamoj said.

"'S pretty," he said. "Like you."

"She hasn't even had a chance to unpack," the woman said.

"Unpack what?" he asked.

"Her suitcases. Trunks. I don't know." The woman looked at the two servants. "Whatever her belongings came in."

"She donnee have any, Colonel Pacal," the plump woman said.

The tall woman looked startled. Turning back to Lionstar, she said, "Saints above, Vyrl. Didn't you arrange for her things to be brought up?"

"If it hasn't been done," he growled, "then do it."

The woman blinked at him. Then she turned to Kamoj and spoke gently, as if Kamoj were a child instead of a grown woman. "Do you have things you would like? We can send someone down to Argali House in the morning."

Kamoj nodded. "Thank you. Lyode will know what to send."

"Lyode?" the woman asked. "Is that a person?"

Lionstar scowled. "Dazza, stop interrogating her."

Kamoj wished they would decide what to call one another. Was the tall woman Dazza or Colonel Pacal? Was Lionstar a governor or a prince? The tall woman had called him Vyrl. A shortened version of Havyrl, probably. Perhaps if she thought of him by a nickname, it would make all this seem less intimidating.

Vyrl dismissed the servants and Dazza again, and this time he glared until they left. Then he pushed open the door. The staircase beyond spiraled up inside the tower at this end of the palace. Although the steps had been repaired, the rough stone was otherwise untouched. The only windows were slits high on the walls. No glass showed in them, just the light curtains.

They climbed three flights to a landing. Vyrl opened the door there and escorted her into a spare chamber only a few paces across, its stone walls polished but unadorned. Its inner door opened into a large, austere bedroom.

Kamoj had last seen this suite with snow drifted across its broken floor. Now the floor was whole, a smooth expanse of stone with no rugs. The walls were also bare stone, except for two crossed swords over the bed. No fire burned in the hearth, yet the room felt warm. The tanglebirch furniture was new: a solid desk, chairs, and a wardrobe against the far wall, all made from wood with blue and green highlights in scale patterns. The bed on the dais to their left had always been there, but now its posters were repaired and varnished, its covers and canopy new. In the wall next to it, a door stood ajar, revealing a corner of the bathing room. Everything was clean, fresh, and devoid of ornamentation.

One unexpected touch softened the decor; across the room, a curtain made from strings of sparkling beads hung in an archway.

Vyrl squinted at the room. "'S not so good for a wedding night, is it? Solar told me this."

"Solar?" Kamoj asked.

"One of the housemaids." Vyrl led her to the beaded archway. "She said she'd prepare a place for you." He pulled back

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the beads, moving aside for her.

Kamoj stopped, both charmed and awkward with his offer to let her enter first. Deciding it would be ruder to refuse his courtesy than to precede him, she walked into the small room.

She saw the difference immediately. This room felt warm in a way that had nothing to do with temperature. Tapestries softened the walls and the delicate sunglass furniture sparkled. The shutters across the room were open, revealing a stained glass window with a rose in its center. To her right, a comforter lay on the floor, and posts rose from each of its corners, totems like those on her bed at home. Kamoj wondered why they put the bedding on the ground. Then she remembered. This chamber had been a second bathing room. Vyrl's people must have filled the small pool with mattresses for her bed.

"This is all for me?" she asked.

"Can't be for me," Vyrl said. "I'd break those chairs if I sat in them."

She almost laughed, but held back, unsure if he meant it as a joke. Jax never joked about himself, a subject he considered of great weight.

Watching her, Vyrl smiled. It gentled his entire face, making him look like a farm boy. He slid his arms around her waist and pulled her into an embrace. "Ever since yesterday, I've been thinking about you. I still can't believe you agreed to this." Then he bent his head to kiss her.

Flustered again, Kamoj stood still while his pressed his lips against hers. The rum smell of his breath clogged her nose.

Vyrl lifted his head. "Is it that bad?" Wincing, he said, "I am as rude as Dazza suggests, yes? I'll go clean up." He tilted his head at a wardrobe against the wall. "Will it harm your dress to go there tonight? Tomorrow the housemaids can tend to it."

The wardrobe, an antique called the rose cabinet, gleamed now. Someone had even redone its carvings, and a mirror bordered with frosted vines hung on one door.

"Camber?" Vyrl asked.

It took her a moment to realize he meant to say her name. "Kamoj," she said, too disconcerted to stop the correction before it came out of her mouth. Too late, she realized what she had done. Tensing, she started to raise her arms, to shield her face.

But Vyrl didn't hit her. Instead he reddened, as if embarrassed. "My sorry, water sprite. I'm terrible with names." Taking her shoulders, he kissed her again. "Don't go away." Then he spun on his booted heel and strode out of the room. The bead curtain swung in his wake, clinking and sparkling.

Kamoj blinked, even more unsettled now. She pushed her hand through her hair, mussing the vine of roses that hung around her neck. Then she went to the curtain and looked out. The main bedroom was empty, but she heard water running in the bathing room. She slipped off her shoes so she could walk without being heard. As she limped to the entrance, pain stabbed her heel. Crammed in her shoe, her foot had gone numb, but now that she had freed it, the wound began to hurt again.

Under her push, the foyer door swung open as smooth as oil on glass. She crossed the entrance chamber and edged open the outer door.

Guards.

Two stagmen stood posted on the landing, Azander by the door and another man several paces away by the wall. She had seen the arrangement before, with Jax's bodyguards outside his room when he stayed at Argali House.

Azander looked down at her. "Be there a problem, Gov'ner?" Although his accent wasn't as thick as an Ironbridge dialect, it wasn't pure Argali either.

"Nothing, thank you." She closed the door, uncertain herself what she had wanted. Why did they guard Vyrl in his own bedroom? To ensure she did him no harm? That seemed rather silly, given

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his size and strength compared to hers, especially now that he didn't need his mask. Besides, they were outside and she was in here. Perhaps they were there to keep her from leaving.

She returned to her room and undid her dress, letting it fall in a heap of satin around her feet. It left her standing in her wedding silks, a translucent pink underdress that came to her knees and pink stockings held up by lace garters. Lyode had claimed such underclothes would evoke pleasant reactions from her groom. Kamoj didn't see why, but she had figured it was worth a try.

She scooped up her dress—and nearly passed out when she stood up. Black spots floated in her vision. The air was too thick, so rich it made her giddy. She swayed, waiting until her head cleared. Then she put away her clothes in the rose cabinet.

Feeling self-conscious, she sat on the bed and sank into its billowy comforter. It it was hard to keep her eyes open. She lay down and let them close, just for a moment.

IV
Stained Glass Moons
Eigenstate Interactions

A crash woke Kamoj. She sat bolt upright, trying to fathom her surroundings. As she came more fully awake, she remembered. She was at the Quartz Palace.

Groggy from sleep, she got up, went to the window, and pushed open the stained glass panes, hoping the night air would clear her head. Outside, the East Sky Mountains slumbered under their carpet of trees.

Three of Balumil's six moons were visible. The Elder Brother shone high in the sky, almost full, casting blue light over the world. The Wild Stag made a ragged green shape just above the trees, lagging behind his brother. For every four times the Elder Brother crossed the heavens, the Wild Stag only managed three. The Brother always presented a serene face to Balumil, passing with regular precision through his phases. The Wild Stag knew no such civilized behavior. Chaotic and unpredictable, he changed both shape and size as he tumbled through the heavens, varying from an uneven disk to a squashed sausage.

The auroras were quiescent, making it one of the rare times Balumil's faint ring showed in the sky. Kamoj could just make out the gold thread curving up from the horizon in the southeast and back down in the southwest. The gibbous disk of the Shepherd Moon glistened pink above the ring. From the positions of the moons, she guessed she had slept seven hours. Dawn was still a long time away: in mid-autumn the days split evenly, thirty hours of darkness and thirty of light. During this season, she usually slept twice at night, once during the hours after sunset and then again in the hours before dawn.

A puffbug flew against the shimmer curtain in the window and stuck. With a frenzied beating of its scaled wings, it freed itself and trilled off into the night, its golden puff vibrating as it sang. Curious, Kamoj pushed her hand through the shimmer. The curtain stretched along her arm like a film. When she pulled her arm back inside, the shimmer clung to her skin, returning to its original shape.

Kamoj closed the window. So odd. For all the beauty Vyrl had restored to her ancestral home, he also brought these strange changes.

Where *was* Vyrl? The fountain still gurgled in the bathroom. What if he had passed out and fallen in the water? Azander already suspected her of foul play against her husband, and many people knew she had dreaded this merger. If something happened to Vyrl, she was the obvious suspect.

Kamoj limped into the main bedroom and went to the bathing room. The door stood ajar, but no one answered her

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knock. She nudged it all the way open, revealing a chamber larger than hers, though still smaller than the main bedroom. A pool filled most of it, tiled in pale blue squares enameled with roses. In its center, the sculpture of a rose opened to the ceiling. She remembered crawling into that bowl as a child and playing with dried leaf-scales that had drifted into it. Now water surged out of the fountain and cascaded down its sides.

A larger-than-human statue stood at the corner of the pool, the figure of a quetzal, that bird named for a mythical creature on a mythical world no one had ever seen. This statue was actually a great stone chair, its scaled head raised high, its back designed from its feathered wings, its upper legs as armrests, its middle legs encircling the seat, and its lower legs as the base of the statue, along with its glorious feathered tail.

Sprawled in the chair, a naked Vyrl was sound asleep.

Kamoj blushed. She didn't know whether to stay or leave. She saw what had caused the crash that woke her. Blueglass shards from a shattered bottle lay scattered around the base of the quetzal. The bottle must have slid out of Vyrl's hand, probably resting on an edge of the statue, gradually slipping, until it fell. His legs were braced against a ridge in its base, his muscles tense even in sleep. It was apparently all that kept him from sliding into the pool.

Picking her way through the glass, Kamoj went to Vyrl. She couldn't stop staring at him, at his broad shoulders and chest, his narrow hips, his long legs, all well-muscled, his skin flushed with health, his magnificent hair tousled around his handsome face. The lamp light made his metal lashes glitter. For all her attempts to imagine his appearance, it had never occurred to her that he might be beautiful.

But did he always drink this way? She thought of Korl Plowsbane in the village, old before his time, wandering with his bottle. Kamoj balked at believing the same of Vyrl. Even if he was like Korl, he couldn't have been drinking that heavily for long. He seemed too healthy. Perhaps he had simply been edgy today over the impending merger.

Still, what she had so far seen didn't look auspicious. She inhaled, letting her nostrils widen so their membranes captured every stray scent under the odor of rum. She caught traces of trees and ferns, a hint of sun on scale-leather, even a lingering trace of Vyrl's disk mail. It all mixed with a strong soap smell and another scent harder to define, a masculine smell she liked. Drawn by Vyrl's scent, she stopped closer and rubbed her fingers along the knuckles of his hand where it lay on his thigh.

"Higher," he said drowsily.

Kamoj snatched back her hand. He was smiling at her, his eyes half open.

She flushed. "I didn't mean to wake you."

He sat up straighter, rubbing his eyes. "How long have I been in here?"

"A few hours."

"Ah." His gaze wandered over her body. Mortified, Kamoj realized she was wearing nothing but stockings and a translucent underdress. Then again, given his "clothes," she was overdressed.

Vyrl grinned. "You look beautiful." He slid out of his chair, and she jumped back, losing her balance as she put her weight on her injured foot. Teetering on the edge of the pool, she flailed her arms.

With unexpected grace, Vyrl slid out of the chair and caught her around the waist. Holding her bent over his arm, he leaned down to kiss her. Startled, Kamoj just stared up at him.

He stopped, then straightened up, bringing her with him. "Don't you ever smile?"

"Well—yes. Of course."

Vyrl stepped away from the pool. "Maybe we should—*ah!*" He lifted his foot and pulled a shard of glass out of his heel. Blood welled up from the cut.

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With a grimace, he stuck his foot in the water and swirled it around until the blood washed away. His graceful way of moving made her think of a greenglass stag.

He smiled.. "Either that's a compliment to me or an insult to the greenglass, I'm not sure which."

"How do you do that?" she asked.

"Do what?"

"Know my thoughts."

"I don't." He took her hand. "Come on. Let's go somewhere with less glass."

They picked their way through the shards and went into the main bedroom. Although he walked reasonably well, several times he put one foot down on the other and stumbled. When they reached the dais with his bed, he stopped, said, "We should do this right," and hefted her up into his arms.

Hai! The last thing Kamoj wanted was a half-drunk man carrying her up stairs. "It's all right," she said. "I can walk."

He started up the dais. "You hardly weigh anything."

They made it to the top with no mishaps, but then he tripped. He took a huge step forward, lunging for the bed, and tossed her across it as he lost his balance. She hit the mattress with a thud, pillows tumbling around her head, and Vyrl landed on top her. Her breath wumped out with a muffled "oomph."

"Ai," Vyrl muttered, rolling off her. "My sorry, Chamois."

This time she was too flustered even to think of correcting the name. When he pulled her into his arms, she stuttered, "Maybe you should, uh, call a healer." She knew she was talking too fast, but she couldn't stop. "For your—for your, you know. Your foot."

"My foot?" He smiled at her. "Why?"

"It's just, mine swelled—Vyrl! What are you doing?"

"Looking at my beautiful wife." As his hands moved, he slid lower along her body. Then he closed his mouth around her breast and suckled her through the glimsilk of her underdress.

Kamoj flushed, blinked, said, "Oh, my," cleared her throat, and coughed. Then she sighed and put her hands in his hair, tangling her fingers in his curls.

Some time later she murmured, "You're different than I expected."

He came back up, cradling her in his arms. "How is that?"

Too late, she realized how her answer would sound: *I thought you would be cruel.* She tried to hide the thought, imagining a blanket to cover it. "You're younger."

Vyrl grinned. "Such sweet words." He fingered the garter that held up her stocking. Then he sat up and tugged the lacy ring off her leg. Setting it on his palm, he squinted at it as if it were another life form. "It's pretty," he said. "But who'd ever think to make such a thing?"

"I don't know," Kamoj admitted. Lyode had given it to her.

Vyrl set the garter on the bed. Then he touched her thigh where the garter had held up her stocking. "So soft . . ." Taking her stocking by the toe, he pulled it off through the gold circlet around her ankle. "And soft here—saints almighty, what is that?"

She wished he would go back to showing her what was soft. "What?"

Vyrl peered at the sole of her foot. "This is serious." He lay on his back and stretched out next to her, reaching his arm out to a tanglebirch stand by the bed. He so distracted Kamoj, she barely noticed him press a panel on the nightstand.

A drowsy voice came out of the air. "Colonel Pacal here."

"Hai!" Kamoj sat bolt upright and clamped her arms over her breasts, looking around for the owner of the voice.

"I need you up here," Vyrl said to the air.

The woman suddenly sounded awake. "On my way."

"For flaming sakes," Vyrl said. "Don't say it like that."

"Like what?" the woman asked.

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"Like 'What has he done to that poor girl?'"

"Is she all right?"

"Her foot is hurt."

"I'll be right there."

"All right. Out." Vyrl pushed the panel again.

After the room remained silent for several moments, Kamoj's pulse calmed. "Who was that?" she asked.

"Dazza." Vyrl drew her back down next to him. "My doctor."

"What is a doctor?"

He tugged apart her arms and pulled them around his waist so she was hugging him. "Healer."

"But where is she? We're the only ones here."

Kissing her, he murmured, "She's coming."

After several moments of discovering that she liked kissing Vyrl far more than she had ever liked kissing Jax, Kamoj moved her lips to his ear and spoke shyly. "If someone is coming up here, shouldn't we get dressed?"

"Ai . . . " He sighed. "I guess so."

While Kamoj sat up, pulling her dress into place, Vyrl went to the wardrobe across the room and took out a blue glimsilk robe with iridescent green and gold highlights. As he was putting it on, a knock came from the entrance foyer. Tying his sash, he crossed the room and opened the door.

Dazza stood outside in rumpled trousers and a shirt, her hair tousled as if she had just pulled herself out of bed. She had something in her hand, Kamoj wasn't sure what. A large black book? As the doctor entered the suite, she glanced at Kamoj, at the stocking on the bed, and at Vyrl. Then she reddened. It didn't surprise Kamoj that the colonel looked like she wished she were someplace else.

"It's her left foot," Vyrl said.

While Vyrl leaned against the bedpost with his arms crossed, Dazza sat on the bed and lifted Kamoj's foot. Her awkwardness vanished as she focused on the problem. "Did you treat this cut?" she asked Kamoj.

"I soaked it in water," Kamoj said.

Dazza looked up at her. "Right away?" When Kamoj shook her head, the doctor said, "If you ever get a cut like this again, clean it as soon as you can." She set down Kamoj's foot and opened her "book." Its top lifted like a box, revealing tubes and squares. When Dazza touched a small square, ghost pictures appeared above the box, rotating in the air, each with a different view of a woman's body. Red and blue lines veined one, another showed a skeleton, and a third internal organs. Kamoj had heard tales of how the ancients made ghosts dance this way, but until now she had never believed them.

Dazza studied symbols flickering on the rectangles on her box. "You're a healthy young woman." She snapped a featherless black quill off her book and bent over Kamoj's heel as if she were going to write on it.

Kamoj jerked away her foot. "What are you doing?"

"Numbing the area." With a gentle touch, Dazza tugged back her foot. "So it won't hurt when I drain the wound."

Although Kamoj found that hard to believe, the pain did indeed recede after Dazza wrote on her heel with her quill. The doctor kept working, though Kamoj couldn't see what she was doing.

"Gods," Vyrl said. "That's a bad one."

Intent on her work, Dazza said, "If we hadn't caught it in time, she could have lost the foot."

Kamoj blanched. No wonder it had hurt so much when Jax jabbed it.

"Kimono?" Vyrl said. "Are you all right?"

Dazza made an exasperated noise. "Saints above, Vyrl. Her name is Kamoj."

He reddened. "My sorry, Kamoj."

Smiling, she said, "It's all right."

Dazza withdrew her quill, catching drops of blood from its tip with her finger. She cleaned Kamoj's heel with a white mesh and then removed a new

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quill from the box. When she pressed a knob on it, a spray came out of its tip and coated Kamoj's sole.

"The nanomeds will aid the healing," Dazza said. "Then they'll dissolve in your bloodstream."

"Non-muds?" Kamoj asked. That made no sense.

"Nanomeds," Dazza said. "Each has an active moiety linked to a picochip—" She stopped, watching Kamoj's face. Then she said, "They're like machines, but so small you can't see them."

"Nanobots?" Kamoj asked.

"Say again?" Dazza asked. "I have trouble with your accent."

"She said nanobots," Vyrl said. "She's speaking Iotic."

Kamoj stared at him. He understood Iotaca? Then again, he had read the contract scroll at their wedding, which was written in pure Iotaca. Maybe he could clear up the mystery of what the blasted thing said.

Dazza, however, also looked puzzled. "Why do you say it that way, as if she used a different language for 'nanobot'? Everything we've said is in Iotic."

Vyrl shook his head. "You and I may be speaking Iotic, but the people here don't. Or not pure Iotic. Their 'Bridge' language is a dialect."

It would never have occurred to Kamoj to describe Bridge as a dialect of Iotaca. The differences seemed too extreme to call them two forms of the same language. But then, to the people of the Northern Lands *any* change was extreme.

"Nanobot is a word from the temple language," Kamoj said.

"I haven't heard enough of your temple language to be sure," Vyrl said, "but I think it's what we call classical Iotic. That contract I read at the ceremony was written in it. What Dazza and I are speaking now is modern Iotic."

Dazza regarded him with curiosity. "You speak the classics?"

"I learned them when I was a boy," he said.

The doctor looked impressed. "You must have had a good education."

He shrugged. "There were no schools where we lived, so my parents brought in tutors from offworld."

Kamoj wondered what he meant by *offworld.* Whatever it was, she too found the result impressive. "I can pronounce words and phrases in Iotaca," she said, "but I don't understand it all. Like *nanobot.* I know the word but not the meaning."

"Do you know what 'molecule' means?" Dazza asked. When Kamoj shook her head, Dazza said, "It's like a tiny machine. A nanobot is designed for a specific duty. Different types have different duties. The ones we carry in our bodies, that help make us healthy, we call nanomeds. Each one has a picochip attached to it, a quantum computer." She paused. "Think of it as a brain. The picochip tells the nanobot what to do and how to make more of itself. If you put a lot of them together, their chips combine into a what we call a picoweb. A bigger brain."

Kamoj blinked. "You put all that in my foot?"

A smile gentled Dazza's face. "I did indeed. Three types of nanomed, in fact. Two help ferry nutrients and structural materials to the wound and maintain your physiological balance while you heal. The third catalyzes molecular repair processes."

"Catalyze?" Kamoj asked.

"Helps them go faster."

"Is she going to be all right?" Vyrl asked.

"She'll be fine by tomorrow." Dazza snapped her quill into her box. Concentrating on her displays, the doctor said, "She should stay off that foot for the rest of the night, however."

Vyrl started to speak, then just smiled. Kamoj flushed. Walking clearly wasn't what he had in mind for the rest of the night.

Dazza closed the lid of her book-box and looked up at Vyrl. "Did you talk to Azander after you arrived?"

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"Not really," Vyrl answered. "Why?"

"He said you were followed by Ironbridge stagmen."

"Ironbridge? Why?"

"Azander seemed to think you would know."

"I've no idea," Vyrl said.

His response disquieted Kamoj. Ironbridge was nothing to ignore. What was Jax up to?

Watching her, Vyrl sat on the bed. "What is it, water sprite? What troubles you about Ironbridge?"

Dazza drew in a sharp breath. Startled, Kamoj glanced at her. The colonel had the look of a healer whose patient had just showed signs of a recovery the healer had feared would never happen. It made no sense to Kamoj. Vyrl wasn't sick, at least that she could see. Except for the rum. But he wasn't drunk now, and all he had done was ask her about Ironbridge.

He hadn't noticed Dazza's reaction. Intent on Kamoj, he said, "Talk to me."

"It is forbidden," Kamoj answered.

"To talk to me?"

"For me to talk of Ironbridge."

"Why?"

"Because you and I have a dowered merger."

"Why does that make a difference?"

She wasn't actually sure why tradition forbade discussing other bid candidates with the winner of a hostile merger. Rules changed in situations like this, when the balance of power tipped so far in favor of one party. "Hostile" was probably the operative word; if she spoke about Ironbridge she could aggravate Vyrl and so bring harm to herself, Argali, and Ironbridge.

"It is forbidden," she repeated.

Vyrl glanced at Dazza with an expression that clearly said: *Can you do something with this?*

Dazza considered her. "If Prince Havyrl gives you permission to speak about Ironbridge, can you do it?"

Vyrl made an exasperated noise. "She doesn't need my permission to talk."

Kamoj looked from Vyrl to Dazza, at a loss to understand the strange hierarchy of authority here.

Dazza tried again. "Can you talk to me about it?"

"No," Kamoj said.

"Who can we ask?"

Who indeed? Maxard, perhaps. He hadn't married Vyrl. He was less likely to incur Lionstar wrath by talking about Kamoj's relationship with another man.

"My uncle," Kamoj said.

"We can send someone to Argali tomorrow." Vyrl grimaced. "Which'll be forever with how long the nights here last."

Kamoj wondered what he meant. Nights weren't long in autumn, not compared to winter, when snow covered the world and blizzards roared down from the North Sky Islands.

Dazza was watching her. "This is about your customs, isn't it? All of you here, you're afraid of showing disrespect. That's important. Respect. To custom, to authority, and to the land."

Relief settled over Kamoj. Dazza understood. "Yes."

Vyrl blinked at the doctor. "Where did you get all that?"

With a scowl, Dazza said, "From talking to your ever-so-patient butler the last time you went riding during one of your binges. I wanted to know why no one stopped you."

"Don't start with me, Dazza."

"Why? Because you happen to be more sober now than you've been in weeks? You're going to kill yourself."

Vyrl ignored the comment. "What did my butler tell you?"

Dazza tilted her head at Kamoj. "They all feel that way. I think they're genetically engineered to obey authority. I've never known such a docile, cooperative people."

"They have armies." Vyrl paused. "If you can call thirty farmers who practice ritualized swordplay every now and then an army."

Kamoj wondered why he found that

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strange. An incorporated man's stagmen rode in his honor guard when needed and otherwise worked to support their families. Ironbridge had the only army that trained all year round. Only Jax could afford to pay a good wage in every season.

Given what she had seen in the past two days, though, it wouldn't surprise her if Vyrl had his men training all year too, while he supported them at a rate ten times greater than anyone else without even realizing it. Most of his staff and stagmen obviously came from Argali. She and Maxard employed the best in the village, so Vyrl must be drawing from the outlying hamlets, which were even more impoverished. By hiring locals instead of his own people, he had been supporting her province even prior to their merger.

"Their 'wars' are more like arguments," Dazza was saying. "In the rare instances when they do fight, it's a ritualistic ceremony. Ironbridge is the only province with real calvary or troops, and they're more of a police force. I doubt you could convince these people to defy authority even if you paid them to do it."

Kamoj blinked. What an odd notion. Why would anyone pay them to be defiant?

Vyrl smiled at her. "They wouldn't. It was just a manner of speech." He didn't see Dazza's startled look; by the time he turned back to the colonel, her face had resumed its normal mien.

"I'll send someone down tomorrow morning to talk to Maxard Argali," he told her. "See if we can untangle all this."

"I think that's a good idea." Dazza packed up her book. She smiled at Kamoj, gratitude on her face. Why? Kamoj saw nothing she had done to make the doctor grateful.

After Dazza left, Vyrl lay back down on the bed. The bags under his eyes had darkened again.

"You look tired," Kamoj said.

"Just a headache. I should have asked Dazza for something." His scowl came back. "But then I would have to listen to her harp on 'my drinking.' Tell me she can 'treat' that too. As if I have a problem. It's ridiculous. I have a few drinks, I go to sleep, I'm fine."

Kamoj knew he wasn't fine. But she had no idea what to say. All she could think of was, "I can rub your head."

"That would be nice, Kamoj." He paused. "Is that right? Kamoj?"

"Yes." She drew his head into her lap. As she massaged him, he sighed and closed his eyes.

After a while he said, "What you said before, about us having a 'dowered merger'—what does that mean exactly?"

"Merger is perhaps not the best word." It implied a more balanced partnership. "Your corporation absorbed Argali."

He opened his eyes. "My what?"

"Your corporation. It was far too big for us to best."

He sat up, facing her. "I don't understand. It was a dowry. I know that's the word. Our anthropologists double-checked. The dowry is the property a man brings to his wife at marriage, right? Drake told me that in your culture, inheritance goes through the female line, and that the women court the men. To get a highborn wife, you need a good dowry. So I, uh, got one."

Dryly she said, "The man is usually more subtle in making his interest known."

He squinted at her. "I don't actually remember what I did. I think I told my stagmen to clear out a storeroom and send the contents to Argali House. I almost fell over when they said you had accepted it."

She stared at him, unsure which stunned her more, his manner of instigating the take-over, or the extent of his corporation. "That was only *one* storeroom's worth of your dowry?"

"Well, yes, I guess you could put it that way." He studied her face. "I don't

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understand how the idea of a corporation got mixed up here with a dowry. You make it sound like I bought you."

That was, in fact, how it felt. Kamoj doubted he would appreciate her saying it, though, so she hid the thought by imagining a blanket over it. "It seems normal to me." She tugged on his arm. "Come lie down again."

His face gentled. "I won't argue with that." He lay down, putting his head in her lap, and closed his eyes. As she rubbed his head, she thought what an irony it was that a merger certain to become a legend may have been a whim born of a drinking binge. Would he regret it tomorrow? What if he changed his mind? She had no wish to return to Jax. He might not want her anymore. If Ironbridge spurned her, Argali would starve, and even if Jax wanted her back she would still be humiliated by the Lionstar rejection.

Vyrl spoke quietly. "My father told me something when I was young: If you plant in the wrong place, you still have to tend the crops."

"Was he a farmer?"

"Yes."

"Am I the wrong place?"

"Gods, no." He opened his eyes. "You're like sunlight. I was lucky. What if the beautiful nymph I saw rising out of the river turned out to have a personality like shattered glass? But regardless, it's my responsibility to see this through now. I would never humiliate you."

Relief trickled over her. She also rather liked being compared to sunlight.

His grin flashed. "I'm glad you like it."

Blushing, she said, "How do you know everything in my mind?"

"I don't." When she raised her eyebrows, he added, "Usually I just pick up emotions. My ability to do even that falls off with distance, roughly as the Coulomb force."

Coulomb force? "I don't understand."

"It's complicated."

Her voice cooled. "And I am too slow to understand?"

"Kamoj, no. I didn't mean that. I just don't know how to explain it, except as I learned it."

"Then explain it that way."

He hesitated, as if unsure how to proceed. "I've an organ in my brain called the Kyle Afferent Body. The KAB. It's too small to see without magnification. Certain molecules in it, that is, certain bits of my KAB, undergo quantum transitions according to how they interact with the fields produced by the brains of other people. That means—well, I guess you could say my KAB varies its behavior according to what it detects. Those variations determine what neural pulses it transmits to certain neural structures in my cerebrum, which interpret the pulses as thought." He stopped, watching her face. "I'm not doing this very well, am I?"

"I don't know," she admitted. "I don't understand some of your words."

He tried again. "My brain can pick up signals from yours and interpret them. The process isn't all that accurate, so it's easier to get emotions than thoughts. It only works close up because the signals aren't that strong."

Although the words made more sense this time, it sounded as strange as before. "You do that with me?"

His voice gentled. "For some reason you're more open to me than most people. I felt it that first time I saw you, when you were swimming. You were so beautiful. So alive. So *happy.*"

She smiled. "So naked."

Vyrl laughed. "That too."

She went back to massaging his head. After a while his lashes drooped and his breathing deepened. Then he jerked, and opened his eyes. When they closed again, he forced them open. Watching him struggle, Kamoj wondered why it was so important to stay awake.

The third time he started to fall asleep, he rolled on his side and pressed his lips against her leg. Distracted, she stopped rubbing his head. He was peel-

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ing off her other stocking, kissing her thigh as the silk slid away. After he had pulled it all the way off, he slid his hand back up her leg. "Your skin is even softer than glimsilk."

Kamoj reddened, flustered again. "Ah. Uh. Oh."

For some reason her idiotic response made the corners of his mouth quirk up. He sat up and pulled her into his lap. "I always thought I liked this room austere. I never realized before how cold it is."

She laid her head on his shoulder. "It would look softer in moonlight."

"Morlin," he said, "turn off the lights."

"Their web contacts aren't complete," a man said.

"Hai!" Kamoj sat up with a jerk and yanked her dress down over her thighs.

Vyrl stroked his hand down her back. "It's all right. He won't bother us."

"He is here? *Watching?*"

"'He' is just a computer web. I call him Morlin." Vyrl hesitated. "The name was supposed to be after an ancient Earth wizard, but I think I got it wrong."

"I'm having trouble completing the contacts," Morlin said. "The molecular engines that repair the fiberoptic cables in this wing stopped replicating centuries ago."

Kamoj pressed her fist against her mouth. Morlin didn't exist, yet he was here.

"I suggest you reconsider trying to use the original web in the palace," the voice continued. "These problems continue to—"

"Morlin," Vyrl said. Watching Kamoj, he added, "We'll deal with it later."

It was quiet after that. Whatever Morlin was, apparently he answered to Vyrl. Gradually, as Vyrl explored her body, Kamoj relaxed against him. She breathed in his scent, spice-soap mixed with his own natural smell.

"Connection established," Morlin suddenly said. The lights went out.

"Hai!" In reflex, Kamoj jerked up her hands to ward off a blow.

"It's nothing," Vyrl murmured, stroking her hair. In a louder voice, he said, "Morlin, shut up."

Kamoj made herself lower her hands. "Does he obey you?"

"Well, yes, you could say that." Vyrl gave her a curious look. "It's just your computer. We're using the old web in this building. Parts of it, anyway. Some of the components are too decayed. Their repair bots failed a long time ago."

Kamoj wasn't sure what he meant, but she knew the palace had been in abominable shape when he rented it. That Vyrl repaired her ancestral home meant more than she knew how to say. She had always longed to do it, but she could hardly have used precious resources to fix a building when babies in Argali needed cereal.

"Look," she said, gazing over his shoulder.

Vyrl turned to look. A ghostly image of the stained glass window in her chamber stretched across the floor out here in the main bedroom, laid there by moonlight slanting through her room. Sparkles glistened in the image, from where the light hit the bead curtain.

"It's beautiful," he said.

She slid off the bed and held out her hand to him. He took it, his face gentling. Together they crossed the room, their fingers intertwined. When they entered her chamber, strings of beads trailed along their arms. The window glowed with light from the Sister Moon.

As Vyrl laid her on her bed, moonlight cast shadows on his robe, making him look as if he were cut from onyx. His callouses felt nubbly on her skin when he peeled off her underdress. Then he paused, kneeling between her legs. Too self-conscious to meet his gaze, she sat up and took off his robe, shy and unsure, trying to act self-assured. She didn't succeed, but he seemed to like how she touched him anyway. She couldn't look at his face because—she wasn't sure why. If she looked, he would somehow acknowl-

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edge her touch, making her too embarrassed to continue.

Kamoj tried to relax. Most women her age were already married, even mothers. Lying down, she reached her arms out to Vyrl. When he stretched out on top of her, he supported his weight on his hands so he didn't crush her under his body.

He took their lovemaking slow and gentle, giving her as long as she needed to relax. Even so, when the time came, she tensed up. It was *tearing*—she wanted him to *stop*—

He went still on top of her. "Kamoj—?"

Hai, she thought, mortified. If she kept this up she would still be a virgin after her wedding night. "It's all right."

Vyrl handled her even more gently after that. The moons shifted in the sky, their light casting a stained glass rose on the floor. He murmured against her ear, saying her name over and over, and right this time. His intensity increased, until finally he drew in a breath and blew it out, the stream of air wafting tendrils of her hair around her cheeks. Then he relaxed on top of her, still murmuring, his voice a soft current of sound against her ear.

After a while his murmurs trickled into silence and he lay still, one hand curled around her breast. He breathing deepened, until eventually it came with a faint snore at the end of each breath.

Kamoj blinked. Apparently they were done. Although the experience had been pleasant, after the initial pain, it seemed incomplete. Was this why Lyode extolled marriage? Certainly it was nice, but Kamoj didn't see why it made her usually no-nonsense bodyguard smile like a besotted fruitwing. Kamoj wondered if in her shyness, she had somehow overlooked or missed the important part.

Vyrl felt heavier now that he wasn't supporting his weight. She nudged him until he rolled off her and stretched out along her side. Then she turned onto her side, her body spooned into his, her back against his chest. He slid his arm around her waist without a break in the rumble of his sleep.

Kamoj drifted in a doze, like the fever-sleep of a delirium, her body so sensitized that she felt air currents whisper across it. She felt restless. Incomplete. Sometimes she awoke to find herself rubbing her own body.

When Vyrl's arm shifted, at first she thought he was restive in his sleep. Then he slid his hand down over hers. As she moved against his hand, he kissed her neck, his teeth playing with her necklace. Whatever he was doing, he knew how to do it well. She felt as if she were trying to climb a peak she couldn't reach. Then the release came, like a crest with many bumps. It spread to the rest of her body, until she lost control and cried out.

When she calmed, Vyrl murmured, "Sweet water sprite."

Kamoj wanted to say soft words too, call her husband beloved and other endearments. Yet she didn't feel she knew him well enough. So strange, to be so intimate, yet so unfamiliar at the same time.

Languor settled over her like a downy quilt . . .

Kamoj wasn't sure what woke her. The moonlight had dimmed, both the Sister and the Far Moon having finished their voyages across the sky. The sense of drowsy satisfaction had also left the room.

She rolled over. Vyrl was lying on his back, staring at the canopy above them, a fixed stare that saw nothing. The tendons in his neck had pulled taut, and his jaw had clenched so hard the bones stood out against his skin.

"Vyrl?" She pushed up on her elbow. "What's wrong?"

He jerked his head. Then he sat up, his face contorting.

And he screamed.

It shattered the silence. He sat with his fists clenched on his thighs, his face

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twisted until she hardly recognized him.

Boots pounded in the main bedroom. "Prince Havyrl!" a man called. The bead curtain rattled as Azander and the other bodyguard swept it aside and strode into the chamber. Scrambling to her knees, Kamoj yanked on Vyrl's robe, covering herself.

Vyrl showed no hint he saw any of them. Staring straight ahead, he worked his mouth like a man in a nightmare trying, with horrific futility, to scream again.

Azander knelt by the bed and shook Vyrl's shoulders. "Prince Havyrl, wake up! You're all right. It only be the nightmares. Wake up!"

Vyrl swung his fist so fast, Azander had no time to duck. Vyrl hit him in the chin, and the bodyguard flew over backward, hitting the floor with a thud.

"Get out!" Vyrl said. "*Now.*"

Azander stared at him, holding his chin. Then he jumped to his feet and the two bodyguards left fast as they had come.

Kamoj slid back, away from Vyrl, until the wall stopped her retreat. Had she been mistaken about her new husband? But no. This was different from rage. Something was wrong, very wrong. He leaned forward, his arms wrapped around his stomach, as if he hurt somehow, not a physical hurt, but something else.

She didn't know how long they sat that way. Finally she moved closer to him. Then she waited. When he neither objected nor showed anger, she came the rest of the way to his side. He turned to her, moisture gleaming under his eyes.

She touched his wet cheek. "What is it?"

"Nothing." He took a breath. "Go back to sleep."

Nothing? He had just split open the night with his scream. She wanted to offer comfort, but she feared it would anger him instead, a risk she couldn't take, not when the well-being of Argali depended on his good will. So she did as he asked, lying down with her eyes closed. She heard him put on his robe, then heard the bed creak and felt the mattress shift.

Kamoj opened her eyes. She was alone. She put on her underdress and got out of bed. Her footsteps made no sound as she crossed to the curtain and peered through the beaded strings into the main bedroom.

Vyrl had opened the window above his desk and was sitting in his chair, staring at the night, his body silhouetted against the sky. He raised a bottle to his lips, and the cloying smell of rum drifted in the air.

Watching him, Kamoj knew that whatever troubled Vyrl, it went far deeper than the rum could reach. What had happened to give a man of such power the terrors that haunted his dreams? □

To Be Continued

*(*The Quantum Rose *takes place in the same universe as Catherine Asaro's Skolian empire novels and also the stories "Aurora in Four Voices" in the December 1998* Analog *and "Light and Shadow" in the April 1994* Analog.*)*

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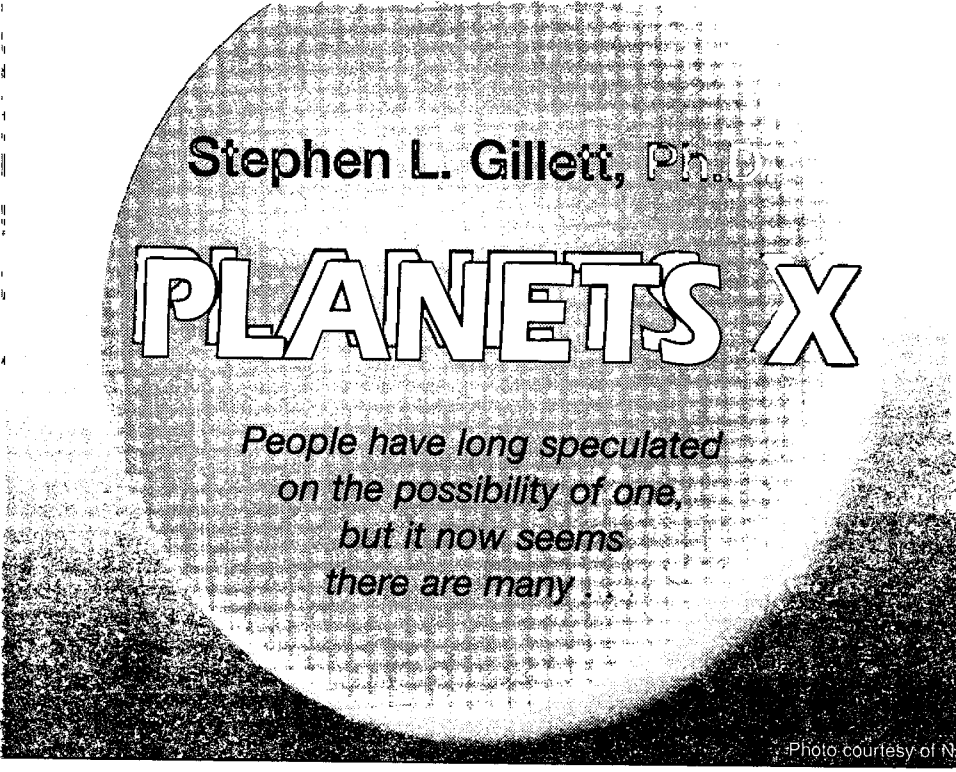
Stephen L. Gillett, Ph.D.

PLANETS X

People have long speculated on the possibility of one, but it now seems there are many . . .



All *Analog* readers have heard the story of Neptune's discovery: it was predicted mathematically from slight wiggles in Uranus's orbit. An unseen body was tugging Uranus slightly out of position, and the direction of the tugs—the "perturbations"—pointed toward the undiscovered planet.

On this basis, a couple of mathematical astronomers, one English, one French, calculated the approximate position of the unseen planet in the 1840s. The Englishman, John Couch Adams, turned his calculations over to the Astronomer Royal, George Airy, who didn't take them seriously; or at least seriously enough to start looking right away.

Jean Joseph Leverrier, the Frenchman, was more persistent. After getting the brush-off from French astronomers, he promptly took his predictions to a more receptive audience in Berlin, where Johann Gottfried Galle immediately discovered Neptune, on September 23, 1846, more or less where Leverrier said it would be. Soon after that the English astronomer James Challis also saw Neptune, more or less where *Adams* said it would be.

Of course, given the fervent nationalism of 19th century Europe, a brouhaha immediately erupted over the proper credit for the discovery. At least in the English-speaking world, Airy is usually cast as the villain of this story, because his delay ensured that Leverrier's prediction was the one that led to Neptune's discovery. But Leverrier received much the same treatment from the French astronomical establishment as Adams did from Airy. Leverrier didn't take no for an answer, though, and kept looking for a more sympathetic group. Hustle and persistence can pay off in science as much as in any other human endeavor. (Let it be noted, too, that Leverrier and Adams didn't participate in the heated controversy over the discovery. They became good friends, and re-

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mained so until Leverrier's death in 1877.)

Neptune's discovery was also a triumph for the law of gravitation. It wasn't so well-established in those days, and hypotheses that the gravitational laws broke down in the outer reaches of the System were perfectly reasonable. Indeed, they seem more reasonable in retrospect, because another anomalous discrepancy in a planet's position *did* herald a problem in Newton's gravitation. Mercury's position also wandered, and Leverrier later used this discrepancy to predict a planet "Vulcan"* inside Mercury's orbit that was perturbing Mercury's position. Despite many searches throughout the latter 19th century, though, "Vulcan" was never found, and it's now quite certain it doesn't exist. The discrepancy ended up being accounted for by Einstein's general theory of relativity.

Planet X?

Anyway, back to Neptune: even after its discovery, there still seemed to be discrepancies in Uranus's orbit. Was there yet another planet out there, still tugging away?

Percival Lowell, better known for his colorful ideas on dying Mars civilizations, thought so. He made elaborate calculations to predict "Planet X's" probable position, and endowed a search program at the observatory he'd built in Flagstaff, Arizona.

The search was delayed many years due to legal wrangling over Lowell's estate. But as all *Analog* readers also know, the resumed search culminated in Clyde W. Tombaugh's discovery of Pluto at Lowell Observatory in February, 1930, some 14 years after Lowell's death. Tombaugh, barely 24 when he discovered Pluto, had found it within a year after getting the search job—a happy circumstance, as will be seen.

Alas, though, Lowell's posthumous triumph has turned out to be flawed. Pluto's position where Lowell predicted was a coincidence. Even from its discovery, Pluto had always seemed too small to perturb Uranus's orbit appreciably. Lowell, of course, thought that "Planet X" was a large planet, with a predicted mass 6.6 times the Earth's. (For comparison, that's a bit less than half as massive as Uranus or Neptune.)

However, every bit of better data gotten on Pluto had the effect of decreasing its probable mass. First it was unexpectedly dim; then its diameter proved unexpectedly small, as shown by Pluto's near-occultations of faint stars. An occultation is an "eclipse of a star," when a nearer body (the Moon, a planet, an asteroid) passes in front of a distant star. Obviously, if the star's a bit off the center of the body's travel, you can place limits on how big the body is by whether it covers the star as it goes by. Still, there remained ways to argue for a substantial mass, though as time drew on they took on the flavor of wishful thinking tinged with desperation.

All controversy about Pluto's mass was finally interred with the discovery of its satellite Charon in 1978. With the satellite we could calculate Pluto's mass directly—and, with only 20% of the mass of Earth's Moon, it's far too tiny to affect Uranus. As Cruikshank, Pilcher, and Morrison, of the University of Hawaii, had put it in 1976, ". . . it appears that Tombaugh's discovery of Pluto in 1930 was the result of the comprehensiveness of the search rather than the predictions from planetary dynamics." Not only is Pluto not at all like an outer planet, it's not even much like a planet, which are after all supposed to be fairly substantial objects.

Was Pluto just found by "luck," then? Hardly. Tombaugh—and Lowell Observatory—didn't rest on their laurels after Pluto's discovery. They continued the search for another 13 years, until it was cut short by World War II, but found no other trans-Neptunian objects. With

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** NOT the Star Trek Version!*

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such a systematic search, it was nearly certain that Pluto would be found sooner or later. The only lucky part is that it was found in the first year, rather than the 14th, as this early success probably helped keep Tombaugh motivated through the tedium of another dozen years of searching. This search also set stringent limits on where—and how bright—any additional Planet X could be. In a 1961 review article Tombaugh concluded that "no unknown planets brighter than the 16th magnitude exist and that any planet between magnitude 16 and 17 had a good chance of being discovered."

(Just a quick review of astronomical "magnitude": each difference of 1 magnitude corresponds to a ratio of brightness of roughly 2.512*, and larger numbers mean *dimmer* objects. Thus an object of magnitude 1 is 2.512 times as bright as one of magnitude 2, 6.31 (2.512 x 2.512) times as bright as one of magnitude 3, and so on. That curious factor of 2.512 is chosen so that a difference of 5 magnitudes means a change in brightness of 100 (2.512^5). Very bright objects have negative magnitudes (e.g., the Sun is about -26.7). The faintest star visible on a clear, moonless night is about magnitude 6. So an object of magnitude 15, Pluto's brightness when discovered, is some 4000 times too faint to be seen with the naked eye.)

As the planetary astronomer Gerard Kuiper once told Tombaugh, what you *didn't* find is more important than what you found. A lot of stuff that might have been out there—isn't. (Kuiper, by the way, almost singlehandedly kept scientific interest in the planets alive during the "long dry spell" between the discovery of Pluto and the onset of the Space Age. We'll be hearing more from him shortly.)

So what caused those discrepancies ("residuals," as astronomers call them) in the first place? Might there be another planet—Planet X—out there that's *still* tugging on Uranus and Neptune? Sure, Tombaugh's work shows that a Planet X would have to be very dim, but it could be dark-colored, or far away, or both. (Or else it's not near the ecliptic, the path along which all the other planets travel. Since the orbits of all the known planets, including the Earth, are in nearly the same plane, they follow pretty much the same path in the sky. For various reasons, though, astronomers don't take the possibility of an "out-of-ecliptic" major planet very seriously.)

Well, a number of people have thought that an actual, massive Planet X existed. They thought the residuals seemed systematic—that is, not scattered uniformly as you would expect if they came from the ordinary (and unavoidable) errors of measurement. After all, it doesn't matter how good your calculations are if you're just working with errors in your measurements! (Or as we say these days, "garbage in, garbage out.") It turns out, by the way, that Uranus is the best planet for determining whether any residuals exist, simply because we've watched it longer. Neptune still hasn't finished an orbit around the Sun since its discovery! For both planets, though, we can augment their measured positions since their discovery with a handful of pre-discovery observations, in which the planets had been seen but cataloged as faint stars. In fact, Galileo recorded Neptune in his notebook, but didn't realize it was anything but a faint star. Moreover, although these prediscovery positions gave a larger data base, they also seemed to make the residuals larger.

Anyway, by the end of the 1980s, several groups had calculated where the "real" Planet X might lie—assuming the residuals were real.

The Planet That Wasn't

So matters stood about 1990. Then two developments changed things beyond all recognition.

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* *To be exact, $\sqrt[5]{100}$ or 2.511886. . . .*

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The first was negative. On the basis of a thorough, "from the top" analysis, Standish (1993) concluded that significant residuals do *not* exist in either Uranus's or Neptune's orbits. Even the pre-discovery positions can be accounted for. All residuals fall within the scatter you expect from experimental error. By comparison, the original residuals in Uranus's orbit, the ones that led to Neptune's discovery, stood out like a semi in a parking lot. As part of his reanalysis, Standish used much better values of the gas giants' masses, a result of measurements from the Voyager fly-bys. Neptune's mass in particular had been relatively poorly known before Voyager, and its wrong mass value proved to account for most of the "non-randomness" in the residuals.

But what about other Planet X predictors? Most of them are pretty flaky. For example, there's a notion kicking around that the aphelia of periodic comets' orbits (the "aphelion" is the farthest position from the Sun on an orbit) cluster near orbits of the big planets. (This idea was first suggested by the French astronomer Camille Flammarion in 1879, by the way, so it's nothing new.) Presumably, a close pass by the planet is what trapped the comet into its short-period orbit. Quite a number of planets have been predicted on this basis, both in the scientific literature and in popular articles. People have found various clusterings of far-out comet aphelia and suggested unknown planets caused them.

It turns out, though, this just isn't true. The usual comet-monster is actually Jupiter, for two simple reasons. First, Jupiter's big, so it influences a large area. Second, it's close to the Sun, so any comet that approaches the Sun closely (which is the only kind we can notice) has a good chance of coming near it. It's hard to avoid, in fact!

Other cometary phenomena are even less distinctive. For periodic comets the time of perihelion passage—when the comet rounds the Sun—is commonly off by a few days from what's predicted. Although some astronomers have tried to explain these discrepancies as resulting from perturbations by unseen planets, there's a simpler explanation: Comets are subject to other forces besides gravity! They're largely balls of ice, remember, so when they warm up vapor boils away. During the Halley fly-by in 1986, for example, the Giotto space probe saw a number of "geysers" and "fountains" of vapor shooting off the comet nucleus. These will act just like haphazard rocket thrusters.

A more spectacular—and trendy—prediction is from the alleged swarms of objects that may impact the Earth every 30 million years or so. Astronomers John Matese and Daniel Whitmire suggested in the early 1980s that Planet X, orbiting at about 80 AU or so, triggers comet showers that make these impacts. (An "AU" is an astronomical unit—the distance from the Earth to the Sun. Pluto averages about 39.5 AU from the Sun.) As its orbit slowly changes its orientation in space, through perturbations from the other planets, Planet X occasionally sweeps through a disk of cometlike bodies that's still outside Neptune's orbit. (This is the Edgeworth-Kuiper belt, of which *much* more anon.) Then its gravity kicks some of these comets into the inner System.

Other astronomers have severely criticized this idea, though, because an object big enough to sweep out lots of comets should also have other gravitational effects—and we don't see them. In particular, it's hard to see why it should disrupt the Kuiper belt only every 30 million years or so, as an object at 80 AU has an orbital period of only about 700 years. Quite a few scientists also think the evidence for periodic impact swarms on the Earth is pretty shaky anyway.*

However, some such planet X couldn't

* *Yours truly being one of them.*

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be ruled out completely. If it were far enough away, but with (say) a very eccentric orbit, it might interact substantially with the Edgeworth-Kuiper belt only every few million years, as perturbations slowly change its orbit's orientation in space.

New Worlds Beyond Neptune

The second new development was astounding: the 1992 discovery of a new trans-Neptunian object, by Jane Luu, then of UC Berkeley, and David Jewitt of the University of Hawaii. This was 1992 QB_1, an object perhaps 150 kilometers in diameter with a discovery magnitude of only 23, some 1600 times fainter than Pluto at *its* discovery. Its aphelion is actually a bit closer than Pluto's, though its orbital period is longer at nearly 300 Earth years.

Since 1993, over five dozen such objects have been discovered, both by Luu and Jewitt and by other teams. (Eighteen were found in 1997 alone!) Suddenly, we have *lots* of "Planets X," though curiously, this enlargement of the Solar System has gotten very little play in the popular press.

The "biggest or brightest" of these objects, with estimates of their sizes, are shown in Table 1. It's easy to see why Tombaugh missed them; even the brightest is only about magnitude 21.5, some 400 times fainter than Pluto was at its discovery. Partly their discovery occurred because Luu and Jewitt were using a considerably bigger telescope than Tombaugh's. In part, though, the new discoveries result from new technology. Instead of conventional photographic plates, Luu and Jewitt were using "charge-coupled devices" (CCDs), which are in effect arrays of semiconductor photocells in which each cell is a picture element, or pixel. Such CCDs are basic to modern TV camera technology, and are in fact why a TV camera has become cheap enough to be a consumer product—your camcorder is a CCD. As you might guess, though, the CCDs used in these astronomical searches are considerably more sensitive than a camcorder, as well as a conventional photographic plate. Not only do CCDs make dimmer objects visible with a smaller telescope, the image is also recorded digitally, so that it's easy to apply noise-reduction and image-processing software.

What's even more remarkable is that this swarm of "Planets X" was predicted, though on a basis completely different from Lowell's. Just before the discovery of 1992 QB_1, planetary scientist Alan Stern (1991) suggested that many more Pluto-sized and smaller objects exist in the outer—in many cases the *far* outer—Solar System. Pluto (or rather the Pluto-Charon pair) may just be the nearest and brightest. Triton—the large close-in satellite of Neptune, which has a retrograde or "backwards" orbit—may be another one.

This sounds spectacular and glamorous, but what's it based on? Stern proposed that the large tilts of both Uranus's and Neptune's axes, the "double planet" Pluto-Charon, and Triton's retrograde orbit all suggest that a lot of Pluto-sized objects were careening around in the outer System right after the planets were formed.

The reason is that all these phenomena suggest impacts with big objects. Depending on what and how it hits, the impactor might tilt a large planet's axis, or two impactors might make a planet-satellite pair if they collided glancingly (this is how Pluto-Charon may have formed), or an impactor might even completely rearrange a satellite system.

Triton, for example, may have been a passerby that had a head-on with a previous Neptune satellite. Not only did that collision capture it into its present weird orbit, it probably also deranged the rest of the Neptune satellite system. All the other gas-giant planets have a set of "regular" satellites, which have nearly circular orbits and "direct" revolution; that is, they revolve around their planet

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Table 1. Bright Transneptunian Objects

Desig'n	Mag. (max)	a (AU)	q (AU)	Q (AU)	e	Incl. (deg)	Period (yrs.)	Diameter (km) 25%	5%
Pluto	13.6	39.50	29.74	49.26	0.247	17.1	248.25	2350*	
1997 CS29	21.4	43.77	43.51	44.04	0.006	2.3	289.62	265	590
1996 TO66	21.4	43.73	38.13	49.33	0.128	27.3	289.20	330	740
1997 CT29	21.5	43.61	42.30	44.92	0.030	1.0	287.99	265	590
1994 JV	22.4	35.25	35.25	35.25	0.000	18.1	209.29	105	235
1997 CW29	22.7	39.38	36.26	42.49	0.079	19.0	247.08	130	295
1995 KJ1	22.8	43.47	43.47	43.47	0.000	2.7	286.59	130	295
1994 VK8	22.9	42.90	41.79	44.02	0.026	1.5	281.02	130	295
1996 TS66	22.9	44.18	38.52	49.83	0.128	7.3	293.63	170	375
1997 CU29	23.0	43.38	41.99	44.77	0.032	1.5	285.75	130	295
1996 TQ66	23.0	39.72	34.60	44.85	0.129	14.6	250.36	130	295
1994 TH	23.1	40.94	40.94	40.94	0.000	16.1	261.95	105	235
1997 RT5	23.2	42.24	42.24	42.24	0.000	12.5	274.49	105	235
1994 TG	23.2	42.25	42.25	42.25	0.000	6.8	274.66	105	235
1994 TG2	23.2	42.45	42.45	42.45	0.000	2.2	276.56	105	235
1997 CQ29	23.2	44.38	41.09	47.66	0.074	2.9	295.64	130	295
1997 CR29	23.3	44.82	41.55	48.10	0.073	19.2	300.09	130	295
1996 TK66	23.3	43.07	42.85	43.29	0.005	3.3	282.66	105	235
1996 KV1	23.5	42.97	41.20	44.73	0.041	8.4	281.64	105	235
1994 EV3	23.5	42.71	40.66	44.76	0.048	1.7	279.16	105	235
1993 FW	23.5	43.48	41.56	45.39	0.044	7.8	286.66	105	235
1994 GV9	23.6	43.47	40.95	45.99	0.058	0.6	286.60	105	235
1994 JQ1	23.6	43.89	41.79	46.00	0.048	3.8	290.79	105	235
1995 GY7	23.6	41.35	41.35	41.35	0.000	0.9	265.87	85	185
1997 RY6	23.6	41.36	41.36	41.36	0.000	12.4	265.99	85	185
1996 KW1	23.6	46.60	46.60	46.60	0.000	5.5	318.13	105	235
1995 GJ	23.7	42.91	39.00	46.81	0.091	22.9	281.06	105	235
1995 DC2	23.7	43.85	40.78	46.92	0.070	2.3	290.36	105	235
1996 RR20	23.7	39.93	32.78	47.08	0.179	5.3	252.34	105	235
1996 TP66	23.7	39.77	26.41	53.14	0.336	5.7	250.82	130	295
1997 QH4	23.7	44.36	41.25	47.46	0.070	12.8	295.44	105	235
1993 SC	23.7	39.91	32.28	47.53	0.191	5.1	252.09	105	235
1995 FB21	23.7	42.43	42.43	42.43	0.000	0.7	276.34	85	185
1992 QB1	23.7	44.34	40.88	47.80	0.078	2.2	295.23	105	235
1995 DA2	23.8	36.21	33.67	38.74	0.070	6.6	217.88	65	150
1994 JR1	23.9	39.36	34.75	43.97	0.117	3.8	246.93	85	185
1996 RQ20	23.9	44.33	39.23	49.43	0.115	31.6	295.16	105	235
1995 GA7	23.9	39.46	34.76	44.15	0.119	3.5	247.83	85	185
1997 QJ4	23.9	39.57	34.78	44.36	0.121	16.0	248.89	85	185

The brightest of the known Kuiper-belt objects. **Desig'n** (designation) is the discovery number assigned by the International Astronomical Union (IAU); none of these objects, aside from Pluto, has been formally named yet. **"Mag."** is the approximate *maximum* visual magnitude; **a** is the mean distance from the Sun; **q** and **Q** the minimum and maximum distances (perihelion and aphelion, respectively); a, q, and Q are all given in AU, where 1 AU is the mean Earth-Sun distance. **e** is the orbital eccentricity (the higher, the more elliptical; a perfect circle is zero); **Incl.** is the inclination, in degrees, of the orbit with respect to the ecliptic; and **Period** is the orbital period in years. Two estimates of the diameter in kilometers are given, one assuming a reflectivity ("albedo") of **5%**, the other assuming **25%**. Obviously, the less light reflected, the bigger the object must be to have a given brightness. (The value for Pluto, whose diameter is known from independent data, is flagged with an asterisk.)
For a complete and updated list that also includes *all* the orbital elements, see the Minor Planet website at **<http://cfa-www.harvard.edu/cfa/ps/lists/TNOs.html>**.

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in the same direction it rotates. Pre-Voyager, though, both known Neptunian satellites were anomalous: Triton, with its close-in, circular, but retrograde orbit; and small Nereid, with a large and highly eccentric orbit. Voyager, however, discovered 4 tiny new satellites orbiting inward of Triton, all with circular orbits and direct revolution. They seem to be the relics of Neptune's original regular satellite system. Everything outward of Triton was either swept up by collision with it, thrown out of the Neptune system completely, or in Nereid's case jarred into a highly elliptical orbit.

Triton's capture, the Pluto-Charon pair, the tilt of Uranus: none of these is an especially likely thing to have happened. That all of them *did* happen suggests there once was a *lot*—hundreds to thousands—of Triton and Pluto-sized objects roaming around. If enough objects are careening around, a few will manage to hit in some very bizarre ways.

In addition, both Pluto and Triton seem to be different from your usual run-of-the-mill outer planet satellite. They're denser, and so must contain bigger rock cores. By contrast, typical outer-planet satellites are mostly just water ice.

What were these thousands of swarming objects? They're probably leftover planetesimals; a population of "embryos" that never grew into bigger planets. Pluto-Charon and Triton may just be big survivors that lucked into stable orbits.

What happened to all the others? Most eventually were scattered like spray from a firehose by gravitational encounters with the large planets. Some, such as the planetesimal that tilted Uranus, collided with a major planet. Others were slung clear out of the System, or at least out to the Oort cloud, the vast, exceedingly tenuous reservoir of comets thought to orbit thousands of AU from Sol. It's also thought to be the source of long-period, sporadic comets, objects that appear once and then vanish again into space, not to return for thousands of years as they traverse their enormously elongated orbits.

But other planetesimals and protoplanetesimals probably remain, leftover bits of the solar nebula from which the planets condensed. In fact, Gerard Kuiper had proposed something like this back in 1951, that a diffuse disk of leftover planet-stuff orbited beyond Neptune. It would consist of objects that were either too far away, or in especially stable orbits, for Neptune's gravity to have scattered them away. This idea was anticipated by Kenneth Edgeworth in 1949, but even though he published in a recognized journal, Edgeworth wasn't affiliated with a research institution, and so Kuiper's name became associated with the hypothesis. In belated recognition of Edgeworth's priority, though, these objects are now often called the Edgeworth-Kuiper (EK) belt. (Or EK "disk"; I mentioned it in the last section.)

There was some hard evidence for such a disk of leftovers, too: short-period comets, those with orbital periods of a few decades to a few centuries. (Halley's is the best known.) Unlike long-period comets, which can appear from any angle, these tend to be in the plane of the ecliptic; that is, in the plane where the planets travel. These features suggest a nearer source than the Oort cloud, one moreover that is more or less coplanar with the planets' orbits. The EK belt fits the requirements admirably.

At present, the new trans-Neptunian objects are considered to be large and relatively nearby members of the EK disk, mega-comets in deep freeze, if you will. They've been called "KBOs" ("Kuiper-Belt Objects") or EKOs ("Edgeworth-Kuiper Objects"), neither being names to set the pulse racing. A much better coinage comes from Jewitt & Luu (1995): "Plutinos"—though that's undoubtedly too euphonious and sensible to take root in the technical literature!

Based on their systematic searches, Je-

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witt & Luu (1995) estimate that there may be 35,000 (!) objects >100 km in diameter between 30 and 50 AU. Including all the smaller objects, there may be perhaps 10^8-10^{10} EK objects total, with an aggregate mass of maybe 1 Earth. (With, of course, a considerably larger surface area than Earth!) In fact, in another paper Stern (1996) suggested that the mass density of the Solar System may actually rise beyond Neptune, where you enter the EK belt. Like a circular cookie cutter, Neptune's orbit has chopped out nearly all remnants of the original nebular debris within 35 AU or so of the Sun. You can think of Neptune's gravity as having "eroded" the inner edge of the EK disk.

Of course, these Plutinos have no detectable gravitational influence on Uranus or Neptune, even from as close as some of them get, 30 AU or so. By the same token, it's now *highly* unlikely there's another big planet beyond Neptune. There's no room! Stern & Colwell (1997) suggest there was an accretional "race" between accretion of the Plutinos into larger objects, versus Neptune's throwing them out with its gravity. Much the same happened when the early growth of Jupiter forestalled the development of a planet in what's now the asteroid belt.

Is Pluto a Planet?

On scanning down Table 1, it's striking how many Plutinos have orbits similar to Pluto's; pretty eccentric, and with orbital periods around 250 years. This is hardly coincidental: such orbits are relatively "safe" from Neptune's perturbations. They're in a rough "3:2" resonance, orbiting the Sun twice for every three of Neptune's orbits. Hence they never approach Neptune closely.

Of course, the implication of the discussion so far is that Pluto is merely a Edgeworth-Kuiper object, and not a true planet at all. As Luu & Jewitt (1996) commented, it's ironic that a search intending to find a tenth planet may have had the result of reducing the number of "true" planets to eight!

But Pluto is different; not only is it considerably bigger than the Plutinos discovered so far, it's also unusually bright, more so than its bigger size would suggest. It's some 1300 times brighter than the brightest Plutino, which indicates it reflects light considerably better. But this high albedo actually follows indirectly from its size: Pluto is big enough (and warm (!) enough) to have a tenuous methane atmosphere when it's closest to the Sun. Methane frost formed by that atmosphere's freezing out raises Pluto's albedo considerably. So at this point the simplest hypothesis is that Pluto is an unusually big EKO. Probably, therefore, farther, darker Plutos exist, 2000 km diameter objects whose surfaces are *not* whitened by frost. Stern & Colwell's modeling of planetesimal accretion also suggests that a number of Pluto-sized objects should have formed.

The Outer Belters

An SF cliché, of course, is the Belter civilization, those freedom-loving spacefarers grown wealthy off the resources of the "flying mountains." Well, here we have a considerably *bigger* asteroid belt. After all, there are only about 250 objects 100 km or larger in diameter in the Main Belt; here there may be 35,000.

And, of course, you're way ahead of me here: this is a treasure trove of resources and living space on the outskirts of the Solar System. Sure, solar energy's not as practical: to get the same energy at 40 AU as you do at 2.8 AU, in the Main Belt, you need an area some 200 times greater. But surely an "Outer Belter" civilization would have fusion available, and deuterium is abundant in the hydrogen-rich material of the Solar System's outer reaches. The dark color of these objects also indicates they're carbon rich, covered with tars from the breakdown of methane by solar ultraviolet over geologic time. In fact, overall they'll

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be extremely rich in CHON (carbon-hydrogen-oxygen-nitrogen), the raw materials of life, as nitrogen will be present in ammonia ice.

Such icy bodies may be rich in CHON, but what about structural material? Surely Outer Belters won't be digging caves into the ice for dwelling places. But, along with their fusion capability, such a civilization presumably also would have a well-developed molecular nanotechnology, for which carbon is the most desirable structural material. So they're unlikely to miss having abundant metal.

Finally, these objects have a grand SF implication: they will be way stations to the stars! Futurists such as Freeman Dyson (and SF writers such as Charles Sheffield, in this very magazine) have long proposed that comets will be valuable resources for the star-bound.

But even a small Plutino is a *lot* bigger than a comet.■

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(Hoyt was a science writer living in Flagstaff who for some reason never got the audience he deserved. He wrote several excellent histories on astronomical topics, including the definitive story of Percival Lowell and his colorful notions about Mars.)

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Mark Rich

SMOKING GUN

Sometimes a problem can be turned into its own solution!

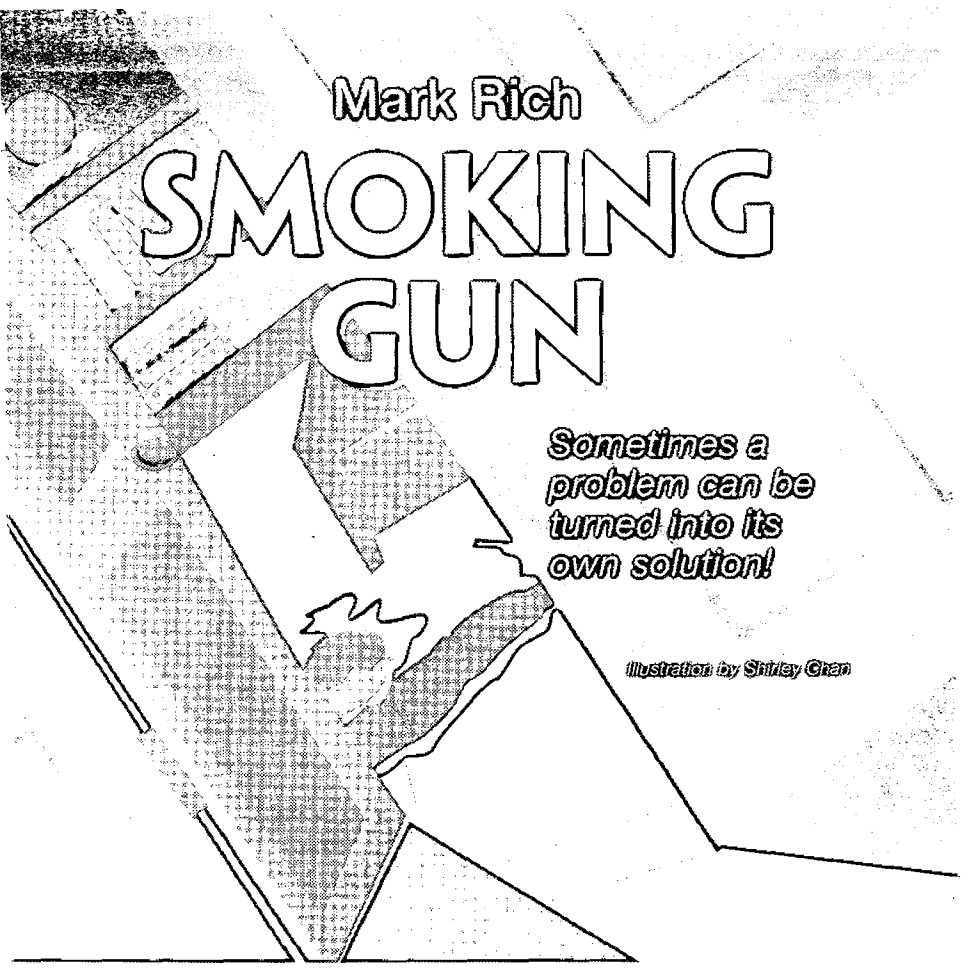

Illustration by Shirley Chan

A sharp report startled me from working on my talk. A backfiring car outside Engleman, I supposed.

A moment later Kristin Belken shoved herself in my door, a wild expression on her face.

Mine must have been the first and probably only door open on the floor. We sat at the dead point of mid-afternoon, when the professors had wandered off to their last classes or to Commons for coffee around the lounge's professorial bull-table, where all the usual interpersonal business could be put to rest for another twenty-four hours.

Kristin Belken panted, as if her lungs hungered for more than mere air. A stricken look filled her eyes.

"I was just entering Engleman," she said, her voice high and tense.

"What's the matter?" I said.

"I *heard* it," she said, "and I ran up! And—oh my god!"

"Tell me what's the matter!"

"It's Professor Manock!"

It feels odd, always, when time nearly stops. It slowed for me while running down this placid hall where several hundred student feet plodded and scuffed each morning and afternoon across undistinguished tile. Death? Here? Hardly felt possible. Yet time came near standing still. I ran, and made no progress, seeing through a portal into a different reality, one in which people moved through air as through gel, their

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movements fluid and moment-by-moment defined. Kristin shot me a knifelike glance—a dull knifelike glance, in this gel-slowed time—and aimed for Lloyd's door on the left-hand side of the hall ahead, at the end.

The door stood ajar.

I nudged it open. Glanced in.

My blood fled my skin and head and senses. I nearly swooned backward into the hall. Kristin put a hand on my arm, steadying me. An iota of reason returned:

"The police," I said.

Somehow we made it to the central staircase and down the steps, taking the left turn at the bottom for the department office, the door of which stood open. Instinct took me there. I could have gone to my office, but I needed a neutral phone. An official one.

The secretary, Marianne, who worked for the combined departments of sociology and psychology, must have stepped out to the mail room. A cooler sat on her desk, labled as being the Biology Department's. I reached over it to pick up the phone and dial campus security. I would leave it to them to contact any further authorities.

I managed to get out the words:

"An emergency, a suicide! Engleman 281. Not a *student*. Just *get* here. This is Schramm. Justin. Schramm. S-C-H—oh, dammit! Just get here!"

Slamming it down I swung myself around and braced myself against the edge of the desk. Kristin stood in the door, leaning against one side. Her expression called back to me my own terror. Before me, in my mind's eye, through the cracked door of Manock's office I saw his form, lying so he faced away from the door, his head in a pool of blood, a hand outstretched, away from me, its fingers spread as if reaching to grasp again what lay beyond reach: the gun. I could imagine it still being warm from the explosion, the barrel itself hot, a trace of smoke emerging from the bore—

Gun? *Gun?* Yet the kind of gun I saw—

I shook my head, leaned back against the cooler, and breathed deeply. I heard Kristin's sigh—a strangled sound. I pushed myself off the desk.

"I have to go look."

"What?"

"Go look. Look again."

"At what?"

"The body. The gun."

"Why?"

"Not sure."

She waited for me to pass before falling in step.

"Don't you think," she said, "we should wait for—?"

She said it quietly, as though accepting already Engleman Hall as Engleman Morgue. Footsteps sounded from the bottom of the west stairs. I wanted to cry out, "There's a dead man here! Have respect! Silence!" Yet it made no sense alarming anyone. Security and the police could arrive and handle this, and keep things hushed.

I thought about that a split second:

Forget it. Everyone will know.

The door plaque said only the necessary: Lloyd Manock, Room 281. No mention of department. No mention of tenure, of Phi Beta Kappa, of honorary degree from Loyola, of early successes, of recent criticisms and failures. The door made a rotten tombstone.

I pushed it open.

I noticed first, I swear, that the *gun* had moved.

Then I noticed—

The *corpse* had, too.

It was gone.

"It's *crazy*, Kristin!" I said.

We stared at the bare spot—or, no, not bare: how could anyone call a space of floor boards with a pool of blood bare?—for only seconds before our nerves grabbed us, both of us, and swiveled us around, back down the stairs and to Marianne's office. I slid my arm over the desk. Something about its

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bare, polished surface made me want to keep stretching out to rest myself there, on its smooth top, to fall into darkness and let my overwrought nerves die into endless slumber. Hyperbole, yes: but I needed extinction.

I grabbed the phone and dialed security. When they answered I babbled.

"That's right. . . . No, this is Schramm. . . . The *suicide*. The body's gone. . . . Of course I saw it! . . . Yes. Yes!"

I turned to Kristin, hanging up the phone. "They're on their way. They were already on their way. I don't know why I called again. They'll be here anyway. I told them we'd be in my office."

She looked at me oddly as I pushed into the hall again. "Why there?"

I shook my head, too wound-up for words. I went up the stairs, leaping them three at a time in my usual manner until the oddity of the situation struck me. The two of us climbed stairs in a building in which someone had just died. Died, and then disappeared. Where could a body go? Nowhere. Yet it had. Dead, on the floor, one moment. The next, gone. Vanished. I thought of movies of the walking dead, and imagined Manock standing, just around the corner, at the top of the stairs, his face deathly pale and his hands outstretched like claws. I stopped in my tracks, and listened. Quiet. Nothing, at all, once Kristin drew to a stop behind me. Did most suicides choose so quiet a time? Or did they choose a moment when they would be noticed, when the most people would hearken to their death-knell? Did Manock wait for this hour of quiet, this hour when only the rare student and rare professor—just me, usually—inhabited Engleman Hall?

"What's the matter?"

"Nothing."

We reached my office. I had the brandy and two cups in hand from the bottom drawer of my desk when we heard the security guard's shoes clattering on the first floor and the whine of a siren in the distance.

It inanely struck me: "Against school policy, *un*official policy, drinking with a student."

"I'm a graduate," she said. "I'm doing work for Manock, before grad school."

"Oh. That's right. Of course." I poured and handed her a glass. The siren neared, stopped. A flashing light enlivened the foliage of the front pines and oak. My window looked that way from Engleman. The footsteps grew louder up the stairs and diminished toward the far end of the hallway, where they stopped—a sudden attack of nerves, I suspected. I gulped my drink and even so heard the small creak of Manock's door being pushed open. Heard then the stepping backward of the guard.

More footsteps, then. The police. They swarmed upstairs. I knew there were probably only two; yet the sound was of a swarm. I refilled my glass and offered Kristin more.

We toasted to no one.

"He never—I mean, Lloyd wasn't ever—I mean he didn't really seem the suicidal type," I said, feeling an awkward constriction in my throat.

"No," she said, looking away.

"But I didn't know him. Not well, I mean. But—you? Was there—no hint of it? That you know of?"

"No. I couldn't have imagined."

"He wasn't depressed about anything?"

"No. Or, maybe, he *could* have been. I don't know. All his work—you've heard. I bet you have."

"I haven't."

"The solvent? He called it a solvent. Not the technical term. A derivative of lysergic acid."

"Of L.S.D.? You're kidding me."

"That's the reaction exactly. 'You've got to be kidding me.' The psychiatric field's up in arms over Lloyd's invention."

"I guess I heard that, some. But you call it an invention?"

"It's a chemical. Or it's an invention. Whatever."

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"You said it was a solvent. What did it—"

"What did it dissolve? Complexes."

"Complexes?"

"Someone called them phantasms once. An old word. I almost like that better." Her voice came out in a monotone. Then she lifted her eyes, caught mine. Her lips twisted. Her eyes clenched and released what they could. She put her head in her hands. "Can't believe I'm sitting here *talking* about this. And Lloyd's *gone*. Can *you* believe it?"

The policeman, Carver, let his languid eyes rest briefly on each of us. Even if it was my office, he owned it just by standing in the door. At least it felt that way.

"The gun hasn't been fired," he said.

"Not fired?"

"Not at all. Brand new. *Never* been fired."

"Unbelievable," I said.

"Why?" he said.

"We *heard* that bang," I said.

"Yes!" said Kristin.

"No one else reported it."

"You're kidding."

"Now, wait a minute, Professor Schramm," Carver said. "You were sitting in this building. But Ms.—"

"Belken."

"You were the *first* to see the body?"

Kristin nodded.

"I thought it was backfiring or something," I said. "So I didn't go see."

"Then it wasn't too loud."

"Backfiring can be pretty loud."

"But no one else noticed."

"You're sure?"

"Aside from you—no reports."

I realized how it must look. A reported suicide. Two witnesses who saw a body in a pool of blood. Then a missing body. A gunshot no one else heard. A gun that had not been fired. Still: that blood on the floor.

It must look crazy.

The waiting area consisted of two couches the color of limes, arranged to make a right angle. A matching carpet completed the square. Sound-damping half-walls stood behind each couch. The clerks and desk-stationed officers, visible from where we sat, busied themselves with whatever their various activities were. We sat where the arm-rests of the couches nearly touched. We leaned toward each other. Something about being in a police station makes one feel dearly attached to a familiar face.

At least I felt that way. In the few yet strangely stretched-out minutes since Lloyd's death I had become attached to Kristin's presence. I found reassurance in meeting her eyes, in giving her a grim smile, in touching her arm when I said something. Her fingers touched mine when she replied.

I could hardly help myself. I made the inevitable comparisons. I noted how she had lighter hair than Margaret had, and lighter eyes; and how her lips had a more sensible cast to them, if less sensuous; and how her cheeks made planes, rather than convexities. Margaret's combination of innocent brightness and dark seductiveness seemed to have no counterpart in Kristin, who showed calm intelligence with a gentle warmth that stopped well short of the matronly yet had a depth beyond the girlish.

I imagined all this, or projected it onto her, in these short minutes: or I directly perceived them, as a person can sometimes under duress. To see to the heart of things: it becomes possible, when time stretches itself beyond the normal bounds, as it did now. I compared her to Margaret, and valued the differences. Margaret hid herself from me who knows where. Kristin sat directly beside me. Margaret had gone: and *good riddance*, one part of me, a part that did not despair, cried out internally.

"Lloyd was interested in suicide," I said to her, whispering as though some reverence needed to be maintained.

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"But as an idea. A topic. We talked about it. Just a few times. So I knew he gave it thought—not as something to *do*. But as a social problem."

"He *was* interested. But you're right. Intellectually."

"Didn't strike me as disoriented. Confused."

"No."

"Had a strong hold on life, I thought."

"Enthusiastic, if that's what you mean."

"He struck me as a planner. A rationalist."

"Not much of a dreamer," she said, nodding. "Except he was imaginative. Great ideas. This whole *dissolver* approach. The solvent. The chemical means of—"

"Psychiatry has gotten so much into drugs."

"Well, yes, but this is—well, it's a different. External application. Doesn't take much. A little to the mucous membrane. To the eyelids. To the lips, or mouth. Even to the ear. Works almost immediately. Blacks you out. Then the psychotropic substance starts in. It dissolves mental complexes. Like the inferiority complex."

Her voice took on a distant sound. She stared into the busy distance of the police office without seeing anything there: she looked back in time, and into her mind. I understood. Memory and thought can let you escape, sometimes. You produce heavy words: complexes, psychotropism, lysergic acid. The weight of these words produces distance and comfort.

"If you apply the solvent to someone suffering from an inferiority complex, they black out, and when they come to, they don't have it any more. It might only be briefly the complex is gone—but it's gone. They see clearly. They see without the filter of the complex. They can be 'normal,' or something that's an awfully lot like whatever it is we call normal. They get a feel for how it is to be that way, free of the complex. And Lloyd said—I mean, *I* believe it, too—that just giving people a chance to get free of mental complexes that bother them and get in their way, just *that* is a good way to fight free permanently from those complexes. How can you get free if you don't know where you're going? You need a goal. If you don't see that goal, perfectly clearly, then you'll never get there. That's what this was all about, the research that everyone in the profession was laughing at. *Is* laughing about. And Lloyd was just creating a way so people could see a goal like that. See *themselves*—only *without* the complex. That way they know what to get rid of. They get the idea of what it's like to be healthy again. A way toward the open and healthy mind."

"I suppose that hurt."

"What did?"

"The laughing. The reaction to his ideas. I guess I heard a little about how much criticism Lloyd was getting."

"Maybe it did hurt. He didn't seem to care. But—" She shook her head, unable to go on for a moment.

I wanted to reach over and hold her hand in mine, to reassure her.

"Mr. Schramm? Ms. Belken?" said a voice behind us.

A broad, heavily built man stood there. He had fair skin and lightly red hair, and wore a yellow shirt and beige slacks. He introduced himself as Detective Avery Anderson. He saw us to a small room divided by a glass partition.

One at a time, we accompanied him to the other side, and answered his questions: "You heard an explosion? . . . How did you react? . . . Why is it, Mr. Schramm, you think the body disappeared? . . . You're *sure* it was there? . . . Can you describe its position again? . . . Have you ever fired a gun, Mr.—I'm sorry, *Professor* Schramm? . . . Any disagreements between you and Professor Manock?"

Common sense screamed for a lawyer to be present. Yet I had no lawyer; and, as far as I was concerned, the turning

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disks of the tape-recorder served me better. It recorded my truth, exactly as I spoke it. I had nothing to hide.

His studied, professional manner, however, irked me beyond compare. "So do you mind enlightening as to the point of these questions? How is this helping us find out what happened to Lloyd?"

"We have only your word that he is dead, Professor Schramm."

"Mine and Kristin's."

"Yes."

"And what is wrong with our words?"

"They're perfectly fine, I'm sure. You're new at the college, is that right?"

"Of course, yes."

"That will be all."

"That will be all? What? This line of arbitrary questions, and then you—"

"You said you have a talk. At five?"

"At seven."

He checked his watch. "You'll need time for dinner."

"Thoughtful of you."

"And if I do have more questions, I'll be able to reach you at—?"

"I'm in the book. If I'm not at home I'm in my office."

"Very good." He sucked the end of his pencil while looking with calm condescension over his notes, which he made in a spiral-bound pad that fit into his palm. It had pink paper. Even the pink paper irritated me.

As we went up the stairs to my place I noticed the dust in the corners of the stairs, the smudge on the window looking north from the stairs, and the light bulb I had forgotten to change again. It would be even dimmer on the way down, after supper.

I had let things slide. Since Margaret slipped away—or no, even before. When things had gone wrong I had taken it personally—although, I argued to myself, why shouldn't I have taken it personally? Wasn't it *my* person to which these things occurred? This love, this break-up, this anxiety and this jealousy and this anger? Hadn't *this* being that called itself Justin become deeply and personally involved, to the point it became resigned and apathetic about its surroundings?

When I opened the door to Apt. B, I felt a rush of relief: to my tension-drained mind it looked less ramshackle and down-trodden than I felt, which made it look appealing and reassuring. Kristin seemed at ease, dropping herself into a couch for a moment and catching her breath—not from the climb up the stairs, but from general circumstances—before getting up and trying to be helpful. We tried assembling pizza and salad simultaneously and bumped each other.

"You have wine," she said, peering in the cooler.

"Want some?"

"You?"

"Have to keep my head clear for the talk."

"You've already had brandy."

"It was bad, too. Should have thrown that out long ago. Forgot how much I hate that stuff."

"Have some wine."

"Thanks."

"But Justin," she said, handing it to me.

"What?"

"You realize what we're doing?"

"What are we doing?"

"We're acting as though Lloyd—"

"Well, we don't know, do we? We don't know! That's why the police are getting huffy because we don't know and they don't know—except I suppose we *do* know and yes, damn it, I *do* feel bad about not mourning—but we're in shock, aren't we? Isn't that where we are? We're in shock and we're fixing supper because we have to do something."

I felt a pain above my eye. A moment passed before I realized I had been roughly rubbing my forehead, as I do when dealing with a problem.

"This thing Lloyd was doing—he found the universal solvent? Sort of a dry-cleaning for the mind?"

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"Oh, no, not really like that—although I admit he used those words, I mean not exactly those words but things like it, because he *was* after that—a solvent. Something to clear the mind. Like if your eyes were all gunked up, it would clean the grime off. That's all. You could see clearly."

"You tried it?"

"I was going to. Sometime. But he was worried about subjecting volunteers—"

"Watch the pizza a moment," I said. "Thought of something. Have to make a call."

Before I ran off to the telephone I glanced at her, and saw an expression on her face—confusion, yes, and some steady bravery, and some simply indescribable *soft* toughness I wanted to do something about.

I nearly forgot what I was calling about, holding the image of her face before me.

Before we left the house it became clear the world knew something.

What the world knew, it felt none too sure itself: but it knew *something*, and that it had something to do with me. Something about death, about suicide—and wasn't I going to speak about suicide tonight?—and about Professor Manock, who was not to be found, who was possibly dead, possibly by his own hand, possibly by some other hand? Wasn't there blood? There, in his blocked-off office? Didn't I have *something* to do with it?

Three news agencies left messages. The campus paper called ("Professor Schramm? This is, um, Mike. Mike Schippert. Call me?"). A blinking on-line monitor: people were trying that way, too.

The stew was thickening. What the thickening agent could be, I had no idea.

"Careful on that ledge!" Kristin said.

"Not so loud."

"Sorry."

"No one's coming?"

"Don't see anyone."

I had climbed one of the oaks beside Engleman, using cornice stones for footing and the knobs and ridges in the tree's bark to reach the ledge on the second floor. I had heard tales about how some new student would try the stunt, once each year.

"What's the matter?" Kristin said, seeing me stop.

"No place to put my hands. Nothing to hold onto."

"Just flatten yourself up against the wall. Hold to that."

"Hold to a *wall?*"

I had no choice. Cheek to brick, hands outspread, and pigeon-toed, moving to the left, I lifted my leading foot and brought it down on something that rolled my sole over the edge.

I caught my weight on my heel, barely.

"Acorn," I said, once I had breath again.

I settled for sliding my feet forward inch by inch, knocking off a few more acorns and sticks.

In front of the window, the ledge conveniently widened. I knelt down, worried. Even if no one on Engleman's second story locked windows, Buildings and Grounds was known to paint many a window shut. Some never opened again.

I sighed in relief: a few tugs on this one would let me in. Unlike students in the new dorms, who have new carpeting, air conditioning and energy-efficient everything, faculty with offices in Engleman feel lucky having windows at all. Forget about screens.

I slipped in beneath the blinds.

I fixed my penlight on the file cabinets Kristin had thought the most likely. She remembered a project-name Lloyd had been acting cagey about. I went for the "S" files, found a series labeled "S.G.," and pulled them out. The first folder had a number of technical papers and notes. The second held, in addition to some more technical information, invoices and a set of odd blueprints.

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Something bounced across the floor. An acorn.

I stared at it, wondering what it was supposed to mean, when a key clicked in the office door. It opened before I could move.

"Ah, Professor Schramm," said Detective Anderson, his flashlight shining in my eyes.

"We were sharing information pertaining to suicide, Lloyd and I were," I said to Anderson.

He switched on the ceiling light and stood in the door with the kind of stiff solidity that suggested a physique of steel rather than mere mortal flesh.

"Is that so?" he said.

"Academics, you know. We exchange things all the time. I just remembered he still had these notes—and I do need them for tonight."

"That's pretty soon, isn't it." He checked his watch. "Why didn't you have someone open the door for you? You could have called Security."

"I thought that might—well, I thought it might look suspicious."

This provoked a raised eyebrow. "And, of course, this doesn't. But why should anyone suspect you of anything, Professor Schramm?" Some of the steel of his frame bled into his eyes.

"*You* tell me why! *You* were interrogating me like a damned criminal!"

"Look at our side, Professor Schramm. You gave us conflicting information before we even reached a scene of apparent violence. A gun was fired. You say. Yet a gun wasn't fired. At least the one we found wasn't. But blood *was* shed. Human. We tested that. So maybe the real weapon was removed. And the body, too.

"As to when it happened, we have only the testimony of you and Ms. Belken. Blood evidence, in fact, suggests that it happened at some earlier time—which might explain why no one else heard. And here you enter the office of the man who's still missing, whether he's alive or dead. You come in by the window. And you've been into the files.

"None of this is like a criminal at all, of course."

"Listen, it's getting late. Come with me to the lecture hall. If you have reason to, you can arrest me afterwards."

"All right, Professor Schramm," said Anderson. "I'll do that. If there's any more funny business—"

"There won't be."

The steel left his frame just long enough to let me out.

Mary Cosina, department chair, hurried over. Something about her broad, square face, pale eyes and graying hair reassured me. Normalcy amidst confusion. I checked my watch. Barely a minute.

"I'll watch from the wings," Anderson said. He leaned against the wall, eyes following me as I headed for the rear stage.

"Mary," I said, as we stood at the edge of the curtain, "you're planning to say a few words first, right? I need a few seconds to go over something."

"I've been trying to get ahold of you. Where *have* you been? You've heard everything about Lloyd? You're going to say what's going on?"

"What do you mean, *heard* everything? Security and the police were keeping it quiet until we knew more."

"*Everyone* knows, Justin," she said. "It's all over the evening news and on the radio."

"Someone must have leaked."

"How *could* this be kept quiet? So you're going to tell everything?"

"What?" I said, startled.

"One of the stations has said you would, tonight. That your talk would give important information about the suicide. Is it true? Is he dead? Oh, Justin, tell me!"

"But how could *they*—" I had realized only an hour before that I *did* have something to say. How did the media know what I barely knew myself? "Go on," I said to Mary. "Go introduce me. And give me a little time, all right?"

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"I guess I'll hear with the rest. Good luck," she said. "*Every*one's watching."

Everyone? I peeked from behind the curtain as unobtrusively as possible and saw that, yes, indeed, the auditorium had filled. I had been given to understand, by Social Issues Club members, that a turnout of twenty would be a rousing success. There had to be a dozen times that, if not more.

And media. I saw microphones, videocams, and technicians wearing earphones that gave them the look of insects.

Then I remembered the folders in my hands and started shuffling through them. What I needed had to be there. I needed something better than just this strong hunch. Once prompted, Kristin had suggested a delivery system that might work thus-and-so. Once given *that*, I knew what I had to look for. Something that would look like a Raven MP25. Twenty-five caliber. Two and a half inches of barrel. Tough-looking and damnably efficient. The country's most popular handgun.

Most popular, that is, if you want to link the word "popular" with the word "suicide."

". . . and *here*, to speak before the Social Issues Club, is Professor Justin Schramm. Justin?"

I stumbled into the shuddering light of photo flashes, hoping my smile resembled not too strongly the grimace I felt like showing the world. Because if I was wrong—

"Hello," I said, as the nervous applause died down. I slapped the folders onto the podium and pawed through the last few papers, hoping I looked less desperate than I felt.

A page slipped onto the floor. From where I stood I could just make out its nature. An invoice, stapled to a diagram. The lines showed it all: stock, chambers, barrel. Explosive chamber? I was betting so. It would *sound* real, to throw someone off. To put someone off-guard—maybe enough so that a spray of solvent would have time to act.

Blueprint for a squirt-gun.

I straightened and began talking, quietly—I hope not too morbidly—about finding the body of Lloyd Manock in a pool of blood.

Then I discussed the idea of people committing suicide to attract attention or make a point.

Then I dropped the bombshell:

"And here, to join me, and perhaps to demonstrate a new *weapon* in the fight against suicide of *any* kind, is Professor *Lloyd Manock* himself!"

I looked over the assembled crowd with anticipation. The hundred or more faces gazed wide-eyed back. I had announced the entrance of a dead man.

An announcement will be greeted as fact, if voiced with conviction. Breathless anticipation conceives itself out of thin air. No ounce of truth need be there. It may be, pound for pound, pure fabrication: and still the souls joined in a room will feel the force of wild surmise, and will glance at one another expectantly. They begin to believe the announced impossible *is* possible. It *will* happen. They will *all* be witness to the unforgettable, the unimaginable, the incredible! Massed humanity draws a single breath of hope, and gazes firmly where the magical will happen.

I stood at that focus.

They hung on my last words spoken, and awaited not my next word but an action—

One entirely out of my control.

I felt upon my shoulder a hand. It tapped me there. I froze cold. The fire leapt to my face. I must have glowed. I had been a fool to believe Manock would hide himself in the audience. He had crept behind the stage, and emerged now from the curtains behind me!

"No," I said, not turning. "Don't speak now, Lloyd. Let me do the talking. Ladies and gentlemen, see behind me the man supposed dead!" The crowd looked at us, jaws lowered. I employed the device

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of showing my utmost confidence in the marvel I had pulled off: I cast not a glance back. To lose the attention of the crowd now would be to lose that vital spark of their awed attention. "Let me! Let me explain how you did it! Lloyd Manock, the man behind me, has been hard at work on his aural-optical system for dispelling the phantasms of our minds—and he has been laughed at by the psychiatric and psychologic professions, just as many a pioneer before him has been greeted with laughter. Many of us knew this laughter—because we may have laughed ourselves! So, I imagine, many of us took it for granted we knew the motive, when we heard the news of his suicide!

"It requires genius of a particular kind to take such derision, yet persevere. On his own, in the privacy of his laboratory, Lloyd continued his work. For his work pointed toward an application that to him seemed instantly clear. He perceived he might instantly solve a social ill with a popular solution. Suicide! He wanted a tool—a *weapon*—against suicide! He simply—"

The hand returned this time not with a tap but a clamp: it locked on my shoulder and forced me around. I spun back to look on Lloyd.

Lloyd was not Lloyd. He was Detective Avery Anderson.

"This has gone on long enough," he said. "You're spouting nonsense. I'm taking you in right now if you don't start talking like you—"

Someone in the audience screamed. A dozen yelled (*He's got a—*) and an earshattering roar burst upon us.

Detective Anderson fell over.

There stood Lloyd Manock, holding a smoking gun.

If the crowd roared that moment, people pressing forward and yelling and others holding themselves back for safety, with dozens screaming and those at the back pushing for the aisles and the doors, the tumult rose into pure chaos when a dazed Detective Anderson, holding his head in his hands, rose groggily from the floor.

Lloyd strode toward me and took the microphone.

"That was a light example," he said, nearly shouting. "Lowest dosage. Only barely—just only barely—enough to make him believe he was shot by a gun. When I shot myself I used the full dosage. So I could prove—prove to myself, above all else—that what I have created is safe! The most dangerous of all weapons! And also the safest! A weapon that can be kept in the house! A full deterrent! To crime! Yet safe! *Not* a weapon that can then be turned toward suicide! Perfect!"

Anderson staggered erect, bracing himself by grabbing one of my arms and Manock's shoulder.

"You're *both* under arrest," he said.

"And here's an example!" Manock said. "This man has received only a light dosage of the solvent I devised. Yet it is enough! He should be in a state of mind in which he is not prejudging me, even though I gave the impression of shooting him! Inspector Anderson, do you feel any anger toward me?"

The man, remarkably, almost grinned. "No, Professor Manock. But I *know* I should. And that's enough for me. So get moving!"

To my amazement, he *chuckled* as he marched us away.

Then he stopped.

"Ah, hell," he said. "Weirdest thing, but I goddamned *believe* you. Go on. Go! Finish your talk."

"We're free?"

"I'll take you in later."

The police released us. With what could they charge us? Manock, for appearing to commit suicide? Then leaving the scene of the uncommitted crime? Or me, for the murder of a man still alive? True, I caused a near-riot with revelations that turned out to be true. Everyone at the speech, on the other

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hand, had expected revelations: Manock had skillfully manipulated the media into giving that impression. *He* broke the silence about his own supposed suicide.

The police did bring charges of battery against Lloyd, on the strength of firing his gun ("It's a delivery system," Manock insisted) at Anderson; but on the advice of their attorneys, and of Anderson himself, they dropped charges. The police, too, saw the light, after all. They saw in Lloyd's gun a potentially kindhearted but effective weapon useful in civil disputes and criminal situations: it would have the *effect* of deadly force. They saw that if they charged Lloyd with recklessness now, the public could later charge the city with the same, if the police adopted and used this new weapon themselves.

Moreover, the police realized, if they could carry themselves through this Manock affair with the appearance of good humor, it might boost their public image. Indeed, Detective Anderson became a local celebrity, and even appeared together with Manock on talk shows.

My own fame came in smaller packages. Yet I savored it. The next Friday, before a house nearly as packed, I finished the talk I started the week before. I *wanted* to talk about this. For Lloyd's discovery took me somewhere mentally I had never seen before: a place of hope amidst the dreary and dim lands of suicide statistics. Lloyd looked forward to the day when homes would replace standard firearms with the new guns.

I knew well the suicide statistics for homes with guns; and I pressed upon the audience everything I knew. These numbers have an effect. People watch and listen closely when a tint and tinge of mortality shimmers before their eyes and a scythe-sweep whispers near their ears: they bend nearer.

A few decades ago, I told them, more than eighty percent of suicides that happened in houses with guns, kept ostensibly for self-protection, used those weapons to kill themselves. A decade later, that figure inched near ninety percent. It took only a few years more to inch past that line.

So why not urge it farther, on to one hundred percent—*if* the homes could be equipped with Manock's guns! Even if a household owned a working Raven MP25 alongside the Manock gun, would not *some* percentage choose the less violent option—to kill the complex, not the self? Surely *some*. Studies of suicide pointed toward that. So many people attempt suicide for the purpose of speaking out, not for self-silencing.

And if *some* would so choose—

In a dark tunnel, any sign of light gives hope.

"So," said the professor, pulling at his graying yet golden hair. "What tipped you off?"

"About what?"

"Your first inkling, Justin. About me. It was the cooler, wasn't it?"

At my nod, he smiled at Kristin. "I left the cooler downstairs. On the secretary's table."

Her eyes flashed understanding.

"It was gone from the desk the second time," I said. "When we went back down. Took me a while to realize that, though. I called the biology department—and found out that some plasma *had* been borrowed."

"I returned it to the biology department," he said. "I mean I returned the cooler, and the empty vials. The plasma—*that*'s still a mess, isn't it? Do you think we'll get it out out of the floor boards?"

I almost made a flippant remark about the stain on his reputation, before thinking better of it.

After all, the stain of engaging in shenanigans despite being a member of respected academia—now *I* had that, too.

And wore it proudly.□

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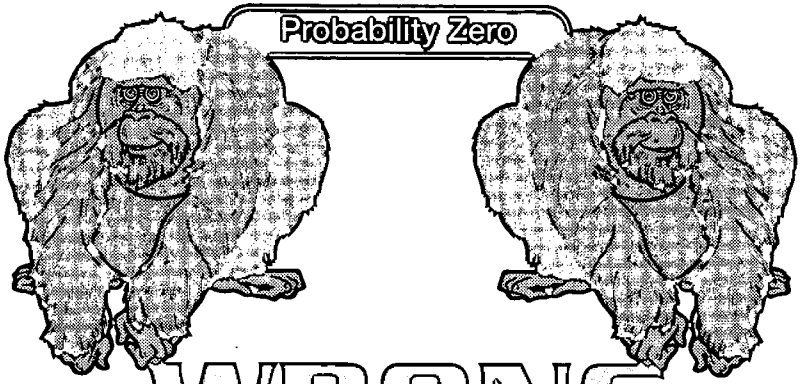

WRONG ANSWERS

Shane Tourtellotte

"Thank you all for coming," Frank Pierpont said, greeting each of the four scientists in turn. "You know how much this means to me, the opportunity to finally prove something I've known my whole life."

Gorillas had been speaking by sign language for twenty-five years now, but narrow-mindedness still barred public acceptance of their intelligence. Doubters droned on about mimicking humans, reading trainers' body language, or any other excuse that would deny the palpable truth.

Pierpont had the answer. He had contacted four scientists from diverse fields, tutored them in the sign language Joe used, and brought them here to speak with him. Under controlled conditions, with disinterested skepticism, no doubt they would confirm what he knew. Their conclusion would be the turning point in his lifelong crusade.

"We are glad to be here," sociologist Sachiko Omizake said, offering Pierpont her hand, "and wish you the best of luck."

"Thank you. Ah."

His assistant, Mary, led in the guest of honor. Joe was a large male, five hundred pounds, with a matted black coat turning to red at his crown. Despite ferocious appearance, he walked in calmly at Mary's beck.

Frank quietly signed to Joe, who hunkered down on the floor and signed back. "He understands you'll be talking to him, and that I'll come if he wants me. Everyone have your earpieces in? Then we'll step outside, and you can have your conversation."

He and Mary slipped through the door, into the next room with the two-way mirror. Frank slipped on a headset. Joe would get no clues from him, but he could interact with the scientists, and watch the fruition of his lifelong work.

Garnet Wynn, the astrophysicist, started. *"Are you pleased to meet us?"* she gestured.

Joe scratched his head for an anxious moment. Then, *"New people. Four. Like*

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people." Behind the mirror, Frank sighed.

"Do you like the people who live with you, teach you?"

"Frank good. Very funny. Like Frank. Like Remy."

"Remy's another assistant," Frank explained through his mike. "He works mornings, so he isn't here now." He switched off. "Didn't know he thought I was funny, but it's working."

They kept questioning Joe. Brett Hanson, the anthropologist, signed him to *"Look behind you."* Joe scooted around to face the mirror. Hanson had to whistle to turn him back around. *"What is behind you?"*

"Glass. Strong Joe in glass."

Frank beamed. "Self-identity. Oh, good Joe. You're showing them."

Wynn and Hanson took to conferring in whispers, as Omizake posed a question. *"What activities do you enjoy most?"*

Joe gestured vigorously. *"Like eating. Many fruits. Big fruits. Like fruits, like nips."*

Frank keyed his mike. "Some of you may know, we gave Joe a Yorkshire terrier two years ago, named Nipper. Joe calls him Nips sometimes."

A momentary unease lifted from the scientists, Omizake in particular relaxing. She was about to ask about the dog, but Joe continued to sign.

"Remy brings melons. Holes. Drink nips from melons. Funny."

The whispers stopped, then became audible. "I can't be understanding that right."

"A gorilla that drinks? I don't even have *friends* who drink anymore. . . ."

Frank had his headphones off. "He said he was scooping out the seeds. Mary, call Remy in, now."

Back inside, psychiatrist Carla Bermudez had kept her composure. *"Joe, do you get to be with other gorillas?"*

Joe swiped at the floor. *"Other gorillas, no talk. Others only like me. No girls."*

Bermudez froze, mouthing the last word with distaste. *"No female gorillas?"*

"Excuse me." Mary made her way through, heading for the nearest telephone.

"Mary girl, too skinny. Fun talk, fun play, but no—" Joe's gesture wasn't part of his vocabulary, but nobody there had trouble comprehending.

The room fell still. Joe tilted his head, wondering. There was no gesture or sound until Bermudez threw up her hands. "I've seen enough," she said, and walked out, her earpiece still in.

The others started removing theirs, but Frank Pierpont waylaid them before they could depart. "What's wrong? What—" He signed Joe to stay, then interposed himself between the door and the nearest panelist. "Doctor Wynn, explain this reaction."

"Explain? *You* explain this elaborate hoax. You obviously coached that creature to regurgitate the most outrageous statements. Insensitive, mocking—I hope you enjoyed your prank. The board of inquiry won't."

She pushed him into the wall and stormed past. "Prank?" he said, stunned.

Omizake walked up, shaking her head. "Really, who would believe such things of an innocent creature? Certainly not an eminent feminist psychiatrist, or an alcoholic's ex-wife."

"B-but his responses—your other questions—you can't doubt—"

"And put *that* display before the scientific community as evidence?" She turned her eyes. "We'll be in touch, Mister Pierpont," she said in parting.

Frank almost chased her, but instead went to Brett Hanson in desperation. Hanson's eyes were glazed, turning back every few seconds toward Joe. "Alcohol . . . sexual predation . . ."

"Doctor Hanson, please."

Hanson wandered past, heaving a crushed sigh. "They must not be as intelligent as we thought." ■

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OUR RUNAWAY UNIVERSE AND EINSTEIN'S COSMOLOGICAL CONSTANT

Much of what you thought you knew about the universe and its expansion may be wrong. That expansion appears to be speeding up rather than slowing down. This column is about recent astronomical evidence for a positive cosmological constant, suggesting that space itself has mass-energy ($E = mc^2$).

In 1913 Albert Einstein developed the general theory of relativity, which today remains the standard model of gravity. A few years later, beginning in 1917, he turned to cosmology, applying his theory to the universe itself, and he discovered a vexing problem. His equations were unable to describe a universe in an unchanging steady-state. Every model universe he considered that contained matter would collapse on itself because of the pull of gravity unless it was expanding. Einstein decided that he must have left something out. He proposed that the empty vacuum must have intrinsic mass-energy, and he added a term Ω_Λ (Greek Omega-sub-Lambda) called the *cosmological constant* to reflect this energy density.

Contrary to what one might expect, in general relativity a mass-energy for empty space produces a repulsive force instead of gravitational attraction. If a volume of gas expands or contracts, the mass density changes, producing a positive pressure that, in the simplest case, follows the Ideal Gas Law ($p = nRT/v$). However if a volume of mass-containing vacuum expands or contracts, the mass-energy density remains constant, and the pressure in this case is *negative*. The gravitational effect of this negative pressure overwhelms gravitational attraction of the mass and results in a net repulsive force. That force grows linearly with distance, becoming very strong at large distances and balancing the tendency of model universes to collapse. Einstein's introduction of Ω_Λ thus made general relativity compatible with a steady-state universe.

Later Edwin Hubble studied the redshifts of distant galaxies and discovered that the universe was expanding. Einstein then decided that he had not needed to introduce Ω_Λ into general relativity. He became convinced that $\Omega_\Lambda = 0$ and that space has no intrinsic mass-energy. He referred to the cosmological constant as "my biggest mistake."

Fred Hoyle attempted to save the steady-state idea, even in the presence of Hubble expansion, by proposing that new hydrogen atoms are spontaneously generated out of the vacuum, continuously refueling the universe and preserving it in a steady state of constant densi-

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ty. This became the standard model of the 1950s. Innovators like George Gamow had other ideas and extrapolated universal expansion backward to a primordial explosion. They talked about a Big Bang at the beginning of the universe and explored its consequences, but few took them seriously.

In the mid-1960s Arno Penzias and Robert W. Wilson accidentally discovered the microwave background radiation left behind by the Big Bang. Gamow had predicted that up to about 400,000 years after the Big Bang the universe was filled with charged particles and therefore "black," because the particles immediately absorbed all light as soon as it was produced. However, at 400,000 years the universe became cool enough that the charged particles, protons and electrons, could pair off to form neutral hydrogen, so that the universe abruptly went from black to transparent. The many photons of light present at that time were liberated into the now-transparent universe. Penzias and Wilson had detected the remnant of that primordial light flash. Their discovery triggered a revolution. Hoyle's steady-state universe model was declared dead and Gamow's Big Bang ideas were transformed from fringe speculation to the standard model of cosmology almost overnight.

Alan Guth later modified the Big Bang model with his "inflationary scenario," which assumes that in the very early stages of the Big Bang, for reasons not well understood, the universe expanded at an exponentially increasing rate under the influence of a strong repulsive force, its radius growing much faster than the speed of light. After inflation subsided the universe continued to expand at a more modest pace, with the expansion rate slowly diminishing under the influence of gravity. This is the currently accepted standard model of cosmology.

But there are new observations that may be in the same class with the discovery of Penzias and Wilson. There is now evidence that the universe is expanding at an ever-increasing rate, that Einstein's cosmological constant Ω_Λ, far from being a mistake, is needed to explain the behavior of the universe, and that space itself may have a net mass-energy. If these observations are confirmed with better data, the standard model must be modified.

Modern cosmology addresses questions related to the Big Bang model with five related parameters: the Hubble constant or expansion rate of the universe (H_0), the mass density of the universe (Ω_M), the previously mentioned cosmological constant (Ω_Λ), the deceleration parameter of the universe (q_0), and the age of the universe (t_0). Up to now, the cosmological constant Ω_Λ has been taken to be zero, implicitly assuming that the vacuum contains no net energy. The deceleration parameter q_0 has been assumed to be positive, with the expansion rate of the universe progressively slowing down under the pull of gravity. Actually measuring q_0 requires a comparison of the observed red-shifts of the most distant visible galaxies with their absolute distances from the Earth. Unfortunately, the determination of absolute astronomical distances is extremely difficult.

Now astronomers have devised a new technique for making distance measurements, using Type Ia supernovas as distance indicators. A Type Ia supernova is a burned-out star in a binary orbit around another star, from which it receives gas that builds up on its surface. After enough gas has accumulated, it suddenly detonates in a thermonuclear explosion that shines with extraordinary brilliance for about a month, then fades away. Such supernovas occur in all galaxies and can be observed (during their 30-day period of brilliance) in our galactic neighbors and also in galaxies that are halfway across the universe. Since the brightness of the supernova a distance r away will fall off as $1/r^2$, a measurement of the light intensity of the

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supernova implies a distance. If one makes a "Hubble plot" of red shift against inferred distance for Type Ia supernovas, one finds considerable scatter around the expected straight-line behavior, indicating that all Type Ia supernovas are not of identical brightness and are unsuitable as distance indicators.

However, a group of astronomers and astrophysicists led by Brian P. Schmidt of the Mount Stromlo Observatory in Australia (Riess, et al, 1998) has found a way around this problem. They track the "light curve," the intensity of nearby Type Ia supernovae with time, as observed through blue and violet filters, and they find that there are significant differences in falloff times of the light from one object to another, from falloff in about 10 days to over 30 days. They used these light-curve differences to generate a correction that brings nearby Type Ia supernovas of the same red-shift to the same intensity. When they made a Hubble plot of red shift against distance using the corrected intensities, the scatter was removed and all of the Type Ia supernovas fell on the same straight line, demonstrating their value in establishing an astronomical distance scale.

They then collected data from 10 very distant supernovas that were studied between 1995 and 1997 using the Hubble Space telescope and ground-based telescopes in Chile, Australia, and Hawaii. They extended the Hubble plot into the distance region where it would be expected to fall below a straight line because of the expected decrease in the expansion rate of the universe due to the pull of gravity, inferring the deceleration parameter q_0.

The result was a surprise. Instead of the supernova points falling *below* the Hubble straight-line behavior as expected, the points for the most distant supernovas were elevated *above* the straight line. The implication of this is that the expansion rate of the universe is not decreasing. Instead, it is increasing, and the deceleration parameter is negative. Another group led by Saul Perlmutter of the Lawrence Berkeley Laboratory has reached similar conclusions (Perlmutter, et al, 1997).

In a previous column (*Analog*, August 1995) I reported the "state of the universe" as viewed from the 1994 "Texas" Symposium held in Munich, Germany, listing estimates of cosmological parameters as of 1994. They were $H_0 = 66 \pm 30$ km/sec per megaparsec, $\Omega_M = 0.1$ to 2, and $t_0 = 8 \pm 5 \times 10^9$ years. These values imply a value for q_0 between about +0.05 and +1.0. At the Symposium there was concern about "the age crisis," the fact that the estimated age t_0 of the universe appeared to be less than the ages of the oldest stars in it. Stars in globular clusters had estimated ages of up to $11.5 \pm 2 \times 10^9$ years and thorium and europium abundances in stars implied ages of up to $15.2 \pm 3.7 \times 10^9$ years.

Symposium speakers generally assumed $\Omega_\Lambda = 0$ for the cosmological constant, but at the time I felt uneasy about that assumption. In my August 1995 column I predicted that a non-zero cosmological constant would soon be discovered. My prediction seems to have been proven correct.

In contrast to the 1994 values, the analysis of Riess, *et al* leads to a negative value of the deceleration parameter of $q_0 = -1.0 \pm 0.4$, a mass density of about $\Omega_M = 0.24$, and a positive value for the cosmological constant of about $\Omega_\Lambda = 0.72$. Because the expansion rate of the universe is increasing, the extrapolation back to time zero which gives the age of the universe is radically changed, and the universe is older than previously estimated. The revised age value is $t_0 = 14.2 \pm 1.5 \times 10^9$ years, almost double the 1994 value. This provides a solution to the age crisis mentioned above. The new analysis gives the value for the product $H_0 t_0$ to be about 0.93, a bit outside the range 0.7 to 0.9 preferred by theorists.

The result may resolve part of the

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Dark Matter problem. Inflationary cosmology requires that the total mass-energy density of the universe is exactly $\Omega_{Total} = 1.0$. Adding the energy density of normal mass to that of the vacuum gives $\Omega_{Total} = \Omega_M + \Omega_\Lambda = 0.96$, i.e., equal to unity within the analysis uncertainties, solving the inflation part of the Dark Matter problem. There remains, however, the problem of the nature of the Dark Matter that appears to be clumped around galaxies, speeding their rotation rates.

What are the implications of these new results for science fiction? The 1998 results carry the message that the universe is not just expanding, it's expanding at an ever-increasing rate, and it will continue to expand forever. Therefore, SF stories, novels, and speculations that are based on a universe that recollapses, e.g., Poul Anderson's *Tau Zero* and Paul Preuss's *Re-Entry*, and Frank Tipler's speculations in *The Physics of Immortality* have been rendered somewhat contra-factual by the new observational data.

Another SF implication of the 1998 analysis is that $\Omega_\Lambda = 0.72$ implies that empty space has a positive energy density, with the negative pressure anti-gravity action of this mass-energy accelerating the expansion of the universe. Many SF stories and novels, by authors including Isaac Asimov and Robert L. Forward, suggest that the vacuum abounds with energy that could be used as a free and abundant energy source for space drives, etc. These new results tend to support that idea, although the implied energy density is very low. It remains to be seen whether the vacuum can be persuaded to give up its treasure trove of free energy.

It is also interesting to speculate on whether there could be some connection between the strong repulsion that produced the initial inflation of the universe and the weaker repulsion that seems to persist even 14 billion years later. Perhaps the cosmological constant is not really a constant at all. ■

AV Columns On-line: Electronic reprints of 90 or so past "The Alternate View" columns by John G. Cramer from *Analog* are available on-line at the URL: *http://www.npl.washington.edu/av*. The papers referenced below can be obtained at: *http://xxx.lanl.gov*.

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There's a lot of people in this world who spend so much time watching their health that they haven't the time to enjoy it.

—Josh Billings

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Bill Johnson

The Vaults of Permian Love

Sometimes it's hard to tell the very old from the very new. . . .

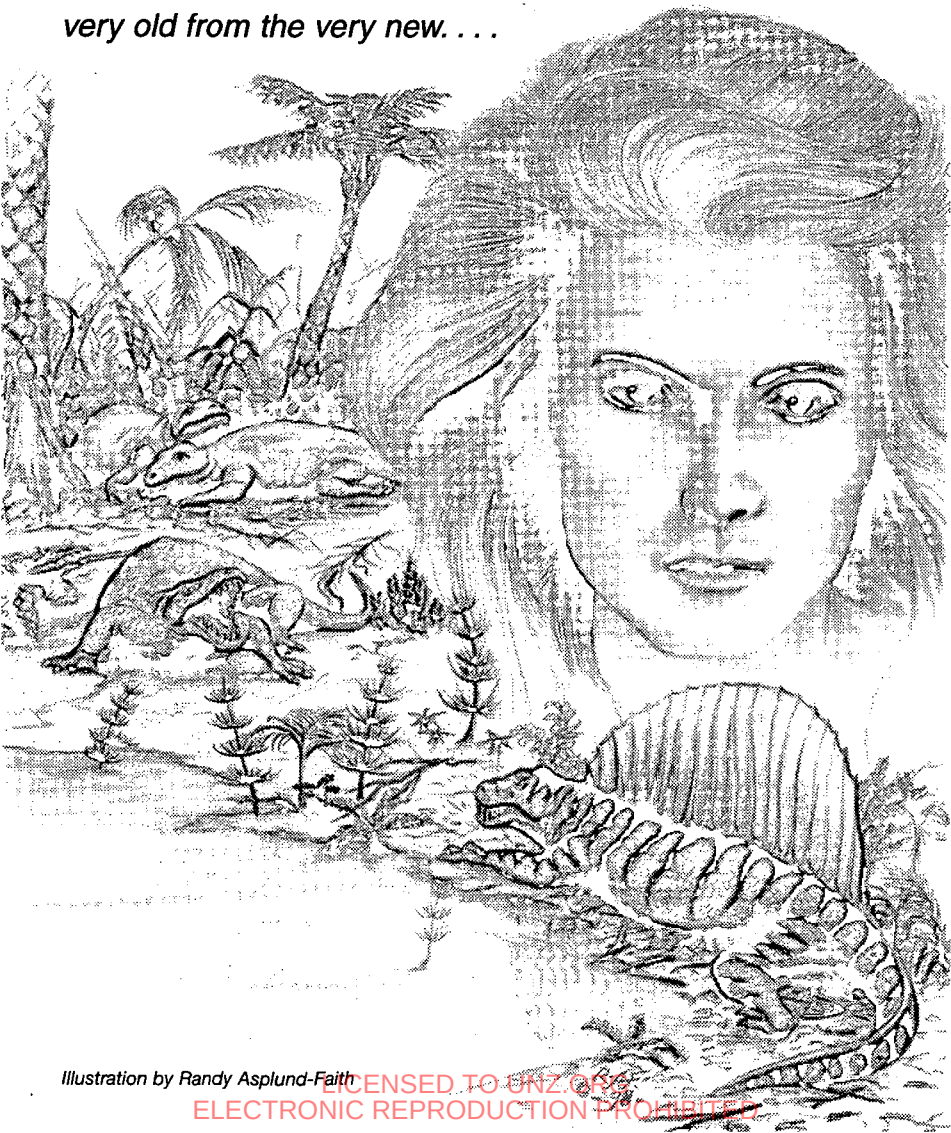

Illustration by Randy Asplund-Faith

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T - 7

The vaults are all gone from my nuclei, and in one week my world will change completely.

I think.

Actually, the date is my own best guess. I can't be exactly sure when the vaults left the nuclei, and I can only estimate when the vaults will reach the ribosomes. Even then, it might take a while for whatever is going to happen, to actually occur.

And I might not even notice any changes.

But I don't think so. I think something really big is going to happen.

I have all the objective records possible. I take my blood and other fluids twice a day, and I always withdraw two samples. One sample I measure immediately with every tool I have in the lab. Then I log the results both on my local network and in my locked account at the National Institutes of Health. The other sample I freeze, so that if I need it later for some reason, I've got it.

Then I measure my reflexes, blood pressure, heart rate, and all the other usual physiological items. I even take off my bra and measure the size of my breasts and nipples, just in case a change shows up there first.

I did all this for a year before I turned the key to open the vaults, to establish a baseline of what was normal for my body. I wanted to make sure that I would know and recognize every vault-inspired change in my body as it occurred.

I don't think all of this will be enough.

I also decided to keep a journal, so I could measure any subjective changes in my emotions and my mind, and my perceptions of those changes.

I just read what I wrote. It sounded so bloodless and cold, like I was some sort of machine. Poke this button, set this parameter, and let's see what happens.

It's not that way at all. I'm scared to death.

* * *

T - 6

It all started because I wanted to cure cancer.

I wish I had some sad and powerful story behind that decision. Sandy told me her story once, about her mother and how she died of breast cancer, misdiagnosed until it was too late and the cancer had metastasized into her lymph nodes and bone marrow and beyond. And her husband, David, got into the business after his brother died of skin cancer.

"It was either this, or join the environmental guerrillas," he told me once. I must have looked confused, so he kept going. "You know, to repair the ozone layer. Maybe he would have lived, maybe not even gotten cancer in the first place, if the UV wasn't so high."

"But you chose cancer research," I said.

"Yeah," he said and half-smiled, half-frowned, as if he was embarrassed. "I really like the beach and Sandy says I look a lot better with a tan. So instead of trying to fix the cause, I'm trying to fix the symptom. Silly, the things a man will do for a woman, huh?"

Not silly at all, I thought, regretfully. *Not silly at all. But, why can't it be me you're worrying about? I would never think you were anything but wonderful.*

Out front, where the world could see me, and more importantly, David could see me, I just shook my head and laughed with him.

Like I wrote earlier, I wish I had a good reason for why I went into cellular research. But I don't. I really wanted to research dinosaurs and ancient DNA, but there was no money in it. I found if I wanted to do basic biochemical research I could either work on AIDS or cancer. That was it as far as grant money went. The dinosaur money ended after the Spielberg movies were over, and the ancient DNA research money went with the dinosaurs.

The AIDS choice scared the hell out

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of me. Not the way AIDS was now, but the way it could become. I studied AIDS in grad school as part of my thesis research. The genetic structure of the virus was elegant and beautiful and damned unstable.

The geometry of the mainline virus, the Central African variation that killed so many every year, was well known. It might kill a million people this year, and infect two million more, but if you wore your gloves and mask and avoided needle sticks with the blood and fluid samples, you were fine.

But then along came a change, like the West African version that showed up in '95 in Ghana, killed a few people, and vanished back into the jungle. Or the Burundi version of '03 that wiped clean the villages in the highlands and then burned itself out because there were no more human hosts to kill. Enough of those incidents and you started to wonder what the next mutation was going to do. Go aerosol, maybe, and spread with a sneeze? Or develop a tougher cell wall so it could survive outside the body for a few days, like a cold virus, and spread through casual contact?

So instead of AIDS I went into cancer research, because that was the only other place to get grant money. And my professors always trained me to follow the trail of research money. And—

The cellular DNA sequencer just finished the daily analysis of my blood. I read the report and the only change from yesterday was that some of the vaults seemed to have reached my ribosomes ahead of schedule. Chemically, however, I was still right on my baseline, with everything I could measure within the margin of normal error.

But the vaults were loose in my cells now. And if I was right, tomorrow would be different.

And so would I.

T - 5

Today the vaults began to open, and I began to change.

I took the usual cell samples from myself earlier in the day and put them through the sequencer. The DNA structures were superficially the same as before, just the normal human genome sequences of A, C, G, and T, with the A's bonded to the T's, the C's to the G's, in the "Outside with outside, inside with inside" alphabetical sequence that every first-year biology student learns. I skipped on down the report, vaguely disappointed that everything looked so normal.

Then I got to the report on my messenger RNA, and I stopped.

The report showed several new messenger RNA sequences. When a gene was actually making something, it generated a messenger RNA sequence, which transferred genetic material from the DNA to the main part of the cell. I monitored the messenger RNA sequences so I could see which genes were working. I knew all the standard versions from my daily testing.

New messenger RNA sequences meant that new genes were turned on. And when new genes turned on, something big was happening to me.

The biggest triumph of early twenty-first-century genetics research was the complete map of the entire human genome. We now could print out the entire three-billion-character sequence of A, C, G, T, which defined a human being. We knew it inside, outside, upside down.

The problem was, we still had no idea what most of it did.

Five percent of the human genome was made up of "coding" sequences called codons, which actually seemed to instruct the cells to make amino acids, and then proteins, and everything else in the human body. The problem was that we had no idea of what the other ninety-five percent, the "non-coding" portion of the genome, did.

Some of it we were pretty sure was just there to provide a structure, a framework, for the codons. Others were

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telomeres, the sequences which indicated the end of a gene. But other parts, as many as twenty-five thousand sequences of varying lengths, seemed to be leftover remnants, inactive and not really doing anything. Some researchers considered these sections the oldest sequences in the genome, and called them "fossil DNA" and ignored them as boring leftovers with no purpose or function.

New genes was the wrong term, I realized. Nothing I had done was going to create a new gene.

What I was suddenly afraid of was that I was looking at something very old. Something which had been asleep for a long time.

And now it was waking up.

I immediately took a new cell sample and ran it through all my instruments again. This time I programmed everything to do a thorough, in-depth analysis. It took the rest of the afternoon, but when I got the results on the computer screen, I saw vaults all through the cells, from the nuclear pore complexes to the cytoplasm.

No one, not even me, knew what vaults really did. They were huge structures by cellular standards, almost as big as ribosomes, but they weren't even discovered until the 1980's. Even then, cellular biologists at first thought they were some kind of lab procedure error. When everyone finally, grudgingly, agreed they truly existed, the real fun started.

Under an electron microscope, the vaults looked like little barrels, fifty-five nanometers long and thirty nanometers wide. Each half was like a flower with eight petals, connected to a central ring by a small hook.

Two flowers combined, petal tip to petal tip, to make one barrel. We called them vaults because they were hollow, and they contained treasure.

Vaults were simple structurally and consisted mainly of two chemicals. The two flowers that combined to make a vault consisted of a protein called major vault protein, or MVP. And inside, tucked away in hidden places, was a cargo of sixteen strands of RNA.

The problem was that even after you accounted for the RNA, the inside of a vault was a big, hollow place. And the vaults traveled from the nucleus to the cell membrane wall, regular as clockwork.

What no one knew was what else, besides the RNA, they carried on their journey, but everyone had a theory.

Sandy and David got our research grant in the first place. They studied why some cancer cells developed resistance to chemotherapy drugs.

Chemotherapy was basically the careful application of poison, and it was designed to kill the most active cells in the body. These were the cancer cells, busy dividing as fast as they could. The best chemotherapy was when the patient was *almost* poisoned to death, so that the cancer cells died, and all the other cells got very, very sick, but did not quite die. This all fell apart if the cancer cells became resistant to the poison.

Sandy and David's theory was that the vaults, with their big, hollow spaces, moved poisonous compounds from the nucleus to the cell membrane, and from there out of the cell, into the bloodstream. Once in the blood, the drugs were excreted out of the body. They based this theory on the idea that as far as a cell was concerned, chemotherapy drugs were just another kind of poison. And the cells with the largest numbers of vaults seemed to be the most resistant to chemotherapy.

My first contribution was to accurately measure the inside space of a vault for the first time. And what I showed was that the space inside the barrel was big, much bigger than expected.

Maybe the vaults did move molecules from the nucleus to the cell membrane. There had to be some way to get poisons out of the nucleus, and vaults were the only structure I saw moving freely inside a cell. But I believed that was only part of what they did.

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My second contribution was when I found traces of messenger RNA inside the vaults.

Not just any messenger RNA either. Unknown messenger RNA. Firmly locked up and hidden, and transported as is it was another kind of poison, then dumped in the bloodstream to be washed away like any other kind of poison. And this RNA had a sequence which was not in any of the reference works.

It was as if there were DNA sequences in the cell, happily and busily making messenger RNA to tell the cell to do something. But the cell never got a chance to do that thing, because the vaults grabbed that messenger RNA and hauled it off like so much garbage, and made damned sure the RNA never got near the nucleus.

"It's something new," I argued. Sandy arched one eyebrow and gave me a skeptical look. She wore her dark hair shoulder-length, but in the lab she always kept it pulled back into a bob, out of the way when she used a microscope. She looked harried, and tired, and beautiful. I always worked weekends with her. Particularly if David was busy and we could be alone.

"Benita, it's probably nothing more or less than contamination," she said. "The vaults already have sixteen different RNA sequences they carry around. Maybe they got broken or damaged or moved around in the sequencer. That happens all the time with the messenger RNA. There's nothing special about this."

"These sequences are new," I argued.

"So?" she shrugged. "Maybe it is something new. Congratulations. Write it up and get a paper out of it. But don't expect me to get excited. This happens all the time. No one has ever mapped out all the RNA sequences. God, it took us twenty years to do the DNA genome. It'll take us another fifty to get everything in the body worked out chemically."

"It is *not* contamination," I said, stubbornly. "My lab procedures are faultless."

She smiled and shook her head. She pushed away from the desk and got awkwardly to her feet. She was eight months pregnant, and she still insisted on working at the lab every day.

"You should go home," I said, concerned.

"Benita, you will be a good aunt to the baby," she said. "You're a nag already. God preserve him when he becomes a teenager and all of his girlfriends have to pass your inspection first."

Sandy reached behind her, balled her hands into fists and pushed on her back with both hands, and stretched. Then she rested her hands on top of her belly.

"What am I going to do at home? I'll spend all my time thinking about my swollen feet, and Braxton Hicks contractions, and how to breathe," she said, and imitated the Lamaze blowing technique until I smiled. "I'd rather be here. At work I don't have time to think about all those things. Like, how is something the size of baby Bubba," and she pointed to her swollen belly, "going to come out?"

She laughed and smiled at me. We knew the baby was a boy, from the sonogram, but David and Sandy still could not agree on a boy's name. I got exasperated once, listening to them argue, and told them I refused to call the baby "it" so from now on, until they settled on a name, I was going to call the baby "Bubba." They both thought that was cute, and the name stuck.

I looked at her, looked at Bubba, sighed, and admitted defeat. It would not do to argue with a pregnant woman. Particularly Bubba's momma.

"So what do you want to do with my RNA?" I asked, temporarily defeated.

"It's not *your* RNA," she said patiently, and sighed when I just looked stubborn. "What I want you to do is to run the tests again. Clean everything to avoid contamination. I'm sure you'll find different results."

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"And you'll go home while I do the work," I said. She started to object, and I shook my head and pointed to the door of the lab. "Home. Get some rest before Bubba arrives here in the outside world. I'm certain he won't give you any rest after that. I'll finish up here. But I won't lift a finger until I see you go home."

"Maybe that would be best," she admitted, and she absent-mindedly rubbed her belly with one hand. "I thought babies were supposed to get quiet when they're this close to term."

"Bubba still kicking?" I asked. Sandy winced and moved her hand over near her right hip.

"Like a soccer forward with a clear goal," she said. She felt her stomach, then reached over and took my hand and held it next to her belly. Her skin was warm through the thin material of the dress. "Here. See? You can feel the foot."

I touched her, gingerly. I felt the hard knot that bulged out from her side.

Sandy was always precious to me. We were assigned as roommates in the dorm our freshman year, and stayed together after we left the dorm and rented an apartment. One night, after we both drank way too much at a downtown bar, I told how I felt about her.

She was gentle and kind and told me she loved me, but not in that way. She was as strongly heterosexual as I was closet homosexual. She tried to let me down easy, and it just made it worse and worse, until I walked away and went back to the bars to drink until I couldn't remember anything more.

We stayed as roommates, until she met David. Then she moved in with him and I moved into my own place.

But I never forgot her, and my feelings never changed.

So I expected a sexual thrill when I touched her stomach in that close, intimate way, but I was disappointed. Instead of the fever she used to bring on in me, there was a subdued excitement, a warm flush, like a fading echo of what once might have been.

And I was surprised because I felt a second emotion, a fierce protectiveness, hot and savage. I outlined the little foot, encased and muffled and indistinct in her belly, and I knew I would do anything for that little person.

T - 4

Today I had a date with David, Sandy's husband.

Sandy scheduled it two weeks ago. She always worried about me, and wanted me to get out of my apartment and the lab. At the same time she wanted to spend an afternoon with her mother without David underfoot. So, in her practical way, she took care of both problems with the same solution.

There was a new exhibit at the Museum of Natural History about life on Earth during the Permian and Pre-Permian eras. One day I found a ticket and a handwritten note in my mail slot at work. I saw David had the same note and ticket in his slot.

We called Sandy "Mom" long before she got pregnant.

There was no way to cancel without bringing attention to myself. So I dressed carefully, and I found my body was already starting to change. My bra was loose, as if my breasts were smaller, and I had to pin up the waistband of my panties. My hips were shrinking, but my thighs were getting larger and more muscular. My knees and elbows were larger, as if I had a bad case of arthritis, but I felt no pain. If anything I felt stronger than ever.

My skin seemed thicker and tighter, but still very flexible. I scratched a fingernail across my arm, and it slid smoothly, as if I were touching nylon armor. There was no white mark left on my skin.

The daily physiological tests showed my body temperature was 104° F, but I felt fine. To check, and make sure I didn't have some kind of fever-induced false lu-

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cidity, I took one of the standard psychological tests.

I scored in the genius levels, twenty points higher than I had ever scored before. I checked the results twice before I carefully and thoughtfully locked them away.

We met at the museum.

David was the opposite of Sandy. Where she was short, he was tall. Where she was dark, he was blonde. Where she was meticulous, he was prone to wild ideas.

They fit together in a way that I could never understand, but that I could always envy. I loved him almost as much as her, but in a different way. With her, I felt a sexual thrill. With him, it was intellectual excitement.

He found me in front of the Permian era exhibit.

"Do you really think all life on Earth was really killed off by club soda?" he asked. I laughed.

"You have one hell of a pickup line," I said.

"Only works on the right kind of girl," he said. He gave me an exaggerated leer. I tried to return it, but my heart wasn't in it.

Why did he marry Sandy?

I never asked the second part of the question, not even to myself.

The exhibit was centered around a computer-animated hologram. It showed a recreation of a shallow Permian tidal basin. Plants and animals and shellfish filled the water and covered the sea floor. Some of what I saw were artists' re-creations based on fossils; others were simply imagination given life.

None of what I saw looked "normal." Shapes that exhibited bilateral symmetry, the property that the right and the left sides of an organism are mirror images of each other, were a distinct minority. Most of the organisms were wildly different from each other, and twisted into shapes that we would call misshapen.

But they looked healthy and prosperous, and they owned the Earth for millions and millions of years.

David leaned forward and reached out to touch one of the plants. His hand slipped through it, and bright points of laser light played on his skin.

"They were everywhere," I said. Suddenly I felt very sad. "Then the Siberian volcanoes erupted, and trillions of tons of carbon dioxide mixed with ocean water, and they all died."

"Death by club soda," David said, and nodded. He seemed to sense my mood. "It was an alien world, Benita. Not like Earth at all. Not like today. The day was a lot shorter, the amount of oxygen in the air was much less. Nothing alive today, none of the plants or animals, could even breathe the air that covered the Earth back then. Hell, even the Moon was closer to the Earth than it is today."

"It must have looked huge," I said thoughtfully. "Imagine the moonrise, right after the volcanoes exploded. All that dust and gas in the air, and this huge Moon rising over mountains and plains and oceans."

"And all the land bare, and all the oceans dying," he said. He wrinkled his nose. "Must have smelled awful."

I laughed again, and the second part of the question popped into my mind, out of my control:

Why did he marry Sandy? Why didn't she marry me?

T - 3

I didn't mean for him to die. God knows, I didn't mean for him to die.

Today started well, particularly after the nightmare of yesterday. I got up, tried to forget, and went through my daily routine with the electron microscope and blood and cellular analysis equipment.

My temperature was still stable at 104° F, and more and more of the vaults had arrived at the ribosomes and discharged their cargoes of messenger RNA. Several new proteins were in my

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blood now, proteins which I had never seen before.

Something old, and something new.

I had no direct proof yet, except for the proteins and the changes in my body, but it seemed very likely to me that the messenger RNA had turned on some of the "junk" DNA sequences which made up ninety-five percent of the human genome. And those sequences coded for the new proteins and for the other changes I felt.

But I wanted more proof.

To finish my morning work, I carefully stained and then examined all my cellular structures through the electron microscope.

The ribosomes themselves looked different now, enlarged and twisted. Changed, but healthy. The nuclei had begun to change form slightly, and the newest vaults were different, not like the altered versions I had used to start my experiment. Those had been modified by me, scarred and twisted, to release the messenger RNA within.

The new vaults looked fresh and healthy, but their structure was subtly changed. Now the messenger RNA was out in the open, carried almost proudly, not hidden furtively away like before.

These changes were all new to me, things I had never seen before.

Correction, I suddenly realized. I looked again. This was the second time I saw the changes.

And memory from yesterday came flooding back.

David and I were still at the museum, and we wandered through the Permian exhibit. In one corner we found a large display, of the contents of an extraordinarily well-preserved fossil of a cell from the Permian.

David frowned.

"It's wrong," he said. He pointed to the cell.

"Now, how do you know it's wrong?" I asked, exasperated. He was a brilliant genetic analyst, but there were times when he was so sure of himself, so stubborn, that it just frustrated the hell out of me to be around him.

"You have samples of Permian DNA back at the lab? Maybe something like the preserved dinosaur blood they found in the mosquitoes trapped in amber? Like that old flat movie, *Jurassic Park*?," I asked jokingly.

"No mosquitoes back in the Permian. Hadn't evolved yet. So no preserved blood," he replied, his voice serious. I scowled, shook my head and dramatically looked at the heavens for patience for a second.

"I *know* that," I said. "It was a joke. Humor. Remember humor?"

"Vaguely," he said, and smiled. I sighed dramatically again and continued.

"What I'm trying to ask is, why are you so certain this cell structure is wrong? I know they didn't get everything from the cell, but it's over two hundred million years old. The cell structure is only a partial deduction, but they could be right," I said.

"Nope," he said firmly. He drew me closer and his finger traced out areas of the cell. "Look at the ribosomes, and the vaults, and the mitochondria. They don't match what we have today."

"But they're close," I argued. "And over two hundred million years, a few things might have changed. Hell, I'm surprised this is all that changed. Ever hear of the thing called evolution?"

He stopped and traced the structures again. Across the aisle was a display terminal. The museum was part of the same network ring as our lab, and his password worked.

He called up the analysis of the bits of DNA found in the cell when they dug it up, and others with it. He pointed triumphantly at the sequences, and I came over to see them close up.

"Look, Benita, I told you they were wrong. If this was the real genome, then they had both males and females back then."

"All right, they had discovered sex," I

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said. I tried to make a joke out of it, but he was so damned serious. "I always knew the Permian was a great time to be alive."

His finger paused in its motions, then jumped to another section of the code. He looked at me and shook his head.

"You don't get it, do you? If this was right, then they had males and females. *And some other kind of third sex back then, to go along with the males and the females.* Something we don't have anymore," he said.

"Gay trilobites?" I asked. He rolled his eyes and shook his head.

"Feeble humor," he said. "And maybe you're closer to the truth than you think."

"What do you mean?" I asked.

"Male and female," David said. "You need one of each to make an offspring. Sex takes a lot of energy, but it mixes a population's genes pretty effectively. Natural selection takes over from there."

"So why is this wrong?" I asked, and pointed to the genetic image.

"Why a third sex?" he asked. "Takes a lot of energy. What purpose would a third sex fulfill?"

"Why are people gay?" I shot back, a little angry. He might not know it, but he was talking about me. "Every survey I've ever seen showed that five or six per cent of the population is gay. There's nothing they can do about it. And why should they?"

"Exactly," he said, and looked proud of himself.

"Look," I said, finally angry. "People don't choose to be gay, any more than they choose to be straight. They just *are*."

"That's exactly my point, Benita," he said patiently. "Don't be angry with me. Think about it. Male and female make an offspring. That's an evolutionary advantage, to have offspring. Those offspring pass on the genes of their parents. Think of babies as a way for DNA to make more DNA.

"Same-sex pairs don't have offspring. So they have no way to pass their genes on. There's no way for their DNA to reproduce," David said.

"But there have always been same-sex pairs," I argued. "Homosexuality has been around forever. Regimes have tried for thousands of years to stamp it out, but the percentage never seems to change. If the purpose of homosexuality isn't to pass on DNA, then what is the purpose? How do you explain that?"

He shrugged.

"Maybe things were different back then. Maybe gays are supposed to be some kind of third sex, with some kind of evolutionary advantage, and the third sex got suppressed. Existence must have been tough during the extinction that ended the Permian. Maybe, for a while, life just couldn't afford a third sex."

I stared at him for a while, then took him by the arm and pulled him away from the display.

"Come on," I said. "It doesn't make sense and I don't want to waste any more time on it. Let's go see the rest of the exhibits."

We worked our way through the rest of the museum, and we both forgot about the Permian, at least for a little while. David hated lines, so we toured while the crowds poured into the food court. We figured we'd eat later, when everyone else was done.

Normally, that would have worked fine for me. But not today.

By the time he was ready to eat, I was starving. Not hungry, but starving, with the shakes and blurred vision and wobbly legs and everything else that normally goes with massive, uncontrollable hunger.

The food court was the usual collection of franchised fast-food places. David wandered around and carefully examined each of the posted menus. They were the same as all the other franchised food places he'd grown up with, but he was methodical in everything he did. And I thought his native optimism always made him think that maybe, just

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maybe, something might have changed this time.

Right.

By the time he came back with a cheeseburger and fries and a drink, I was already halfway through my second tray of food.

"For God's sake, Benita," he said as he sat down and pushed empty Chinese food cartons and crumpled taco wrappers out of the way. "You forget to eat breakfast this morning, or something?"

"Or something," I mumbled as I finished an order of hot and sour soup.

I tried to slow down, but once started I could not stop. I finished everything on both trays and got another. I still finished before he did. But at least all the food filled me up and the shakes were gone. Now I felt uncommonly sluggish with a major food coma, as if I needed to curl up in the corner of a dark cave and digest all I had eaten.

David wanted to see the rest of the museum.

I groaned inwardly, and then painted a smile on my face. I was well known as a museum crawler and it would have been totally out of character to beg off after only one morning. The only excuse I could use was that I did not feel well, and that would have brought Sandy down to my apartment in "Mom" mode. And the first time she felt my skin, and looked at my new body shape closely, I was going to end up in the hospital.

I wasn't ready for that. Not yet. For all I knew, all their attempts to "cure" me might kill me.

Maybe I was getting a little paranoid, but I knew I was going to change into something different than normal. Outside our lab, with all the economic problems, there were dozens of skinhead gangs and militia groups who were violently against anything "different." So I wanted to play it safe.

Like the T-shirt says, even paranoids have enemies.

We toured the rest of the museum for that afternoon. David bounded ahead, enthusiastic. I was tired, more tired than I had ever been. I covered by pretending great and in-depth interest in every exhibit, which meant I needed to stop and read carefully all the information in front of every display. I went so slow it irritated David, but I don't think he suspected anything, and it gave me a chance to rest.

We were some of the last patrons to leave the museum. It was dark outside, and the parking lot was a vast expanse of asphalt neatly dissected and flensed by the arbitrary geometry of the parking spaces, by open-faced white rectangles cut into the black. And all washed by the harsh burning golden light of the sodium vapor lamps.

Our cars were all alone, parked next to each other at the back of the lot, next to a strip of trees. Beyond the trees was an interstate highway. Looming over everything on the other side of the highway was the gaunt shape of a multistory public housing project.

David used his remote to click his car from a few feet away. I did the same. I saw the lights on the cars flicker, and heard the door locks clunk open.

"Got a dollar? Hey, mister, got a dollar?"

The voice came out of the trees at the edge of the lot. Then I saw the shapes as they came out of the shadows of the trees.

My eyes were better in the dark since I started the change. I clearly saw the two figures in front, and the other two that hung back in the shadows. No weapons were visible, but they all wore workout jackets with the hood pulled forward, and their hands were hidden in the pockets of the jacket.

"I'm hungry, mister. Got a dollar for a hot dog?"

They separated and flanked David, one on either side. The two in the shadows moved closer. One of them took his hands out the pocket of his jacket, and I caught a flicker of light reflected off metal.

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David looked uneasy, and tried to turn so he could keep both of the two closest to him in his field of vision. They refused to cooperate, and angled apart as they walked toward him so he had to pick one to look at, and the other came up on his blindside. They all ignored me.

"Sure, I've—"

The one on his blind side struck suddenly, his hand clenched into a fist. He struck at the back of David's head, and punched him so he stumbled forward. At the same time the one in front of him also struck at David's face. The two in the shadows moved fully into the light, and I saw one held a long, thin-bladed knife, like a stiletto.

Everything got very still for a moment. I felt something inside me *change*. Suddenly David was no longer just my friend. Now he was the father of the child of my breeder pair. Now he was someone I needed to protect.

The problem was, my mind was writing checks my body could not yet cover. That was why David died.

I ran forward, and all the memories of a year's time wasted on martial arts training flooded back.

I kicked the side of the knee of the one behind David, and felt and heard the satisfying crunch of bone and tendon. The mugger screamed once and fell hard, his hands clutched at his leg. He moaned and writhed on the ground.

David grappled with the one in front of him. Blood ran from David's nose and lips, and his eyes looked glazed, but he was stronger than the boy.

The two from the woods ran up. I tried to move faster, to get between them and David, but suddenly a wave of weakness washed over me and I fell to the ground. I knew, I *knew*, that in another two days I would be faster and stronger and smarter than anyone in this little morality play. That I was almost finished with my change, and then no one would ever get the chance to hurt David.

But I didn't have two days to get ready.

"Stick him, Freddie. Stick him."

Freddie stuck David with the knife, while I lay on the ground, feverish and exhausted. I panted and shook my head to clear it and tried to crawl forward on my hands and knees. And Freddie stuck David again, and again, until David let go of the other boy.

And then David died.

T - 2

Sandy had contractions last night.

She came to the museum just after the ambulance and the police. Her face was flat and dead, her lips a slash through yellowish-white putty, and I couldn't look at her.

"I'm sorry," I said. I locked my arms around my legs and pulled my legs close to my chest and rocked back and forth, my chin on my knees. "I'm sorry. I'm sorry."

Sandy knelt next to me, and took my head in her hands and turned my face so I had to look her in the eyes. It was a strange sensation. At first I wanted to resist, and I knew I was much stronger than her. Then I felt her touch, and smelled her skin, and I could feel and smell David, or at least that part of David that was in the baby, and I let her move me like a child.

"I need you to be strong, Benita. Right now. I know you're hurt inside, that you loved him—don't look away, I'm not angry—that you loved him. He knew it, too. So I know you watched him die, and you blame yourself, but none of that matters right now. I have the baby, Benita. I don't have the strength right now to be strong for all three of us. I need your help. You have to be strong for yourself, and for David. Help the police, and you help him. And me. And the baby," Sandy said.

She was right.

I took a deep breath, to get her smell into my brain, and accepted her.

I had a job to do.

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I nodded, and she let go of my head. She was so upset that she didn't even notice my elevated temperature. Instead, she stood, with difficulty, and I stood next to her. I led her over to the open door of the ambulance, and helped her up, and shut the door to let her be with her husband. The gumballs started on top of the ambulance, red and amber lights flashing off the windows of the museum, and the ambulance drove off slowly to the morgue. I watched it leave, then I went to the marked police car and gave my information to the uniformed officers, and then again to the detectives.

I took my car home, got a cab back to the museum, took David's car home, got another cab back to the museum, and drove Sandy's car to the hospital.

The attendant would not let me go down into the morgue. I stared at her for a moment, and considered if she should die. Sandy was in the morgue, and I wanted to be with her, to protect her. I thought again about killing the attendant, then reluctantly decided that was bad strategy, and sat down to wait.

A few moments later I realized three things:

First, I had seriously considered killing another human being, just for getting between myself and Sandy and the baby. The idea was alien to my whole life, to an existence spent living on the shelf, watching, observing, but never a part of the play. Now I fully intended to be a participant, to take a major role, and I was willing to do whatever was necessary to get what I wanted.

Second, I felt better than I ever had in my life. I felt light, and full of energy. My reactions were fast and sure, my thoughts clean and logical, and I had no doubts I could do anything I decided to do. If that meant the attendant must die, then the attendant was just a walking dead woman. If that meant the attendant got to live, then she was lucky.

Third, I was tremendously hungry again.

Sandy found me an hour later. Candy and snack food wrappers were stacked in a neat pile next to me.

I stood when she came through the door. She was tired and careworn, and her legs seemed to stagger. I put my arm around her and held her tightly to my side. She slumped gratefully against me.

"It's time to go home," I said.

"He's dead, Benita," she said dully.

"Yes, I know," I said softly, so only she could hear. I held her up easily, and realized that while before we were the same height, now I was an inch taller.

"I don't feel so good," she said. She held her swollen belly. "It hurts."

"Contractions?" I asked.

"Braxton Hicks," she said, and she looked up at me and smiled. "Not the real thing. Not yet."

"We're going home," I said firmly. "I'll take care of you now."

T - 1

The change was complete, but what was I supposed to do?

I took tissue samples from myself, and ran my usual tests on the cells. When I checked the cellular vaults for the ones I had modified, the scarred and damaged soldiers, they were all gone, their cargoes of anachronistic messenger RNA delivered. All I saw was new vaults, clean and fresh and *right-looking*, filling up with messenger RNA and merrily heading off as if this is what they had always done.

Next step was to check my DNA itself. My twisted helix was absolutely normal. Nothing had changed at all. Human genome all the way.

But there were new proteins, and I doubt I caught them all. My lab was not set up to get all of them. But I caught some, and they confirmed that some of the junk DNA was working again.

After how many million years, I wondered. *The Permian? Earlier?*

How old am I now?

My temperature was down, but not to 98.6. I seemed to have stabilized at

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about 101. My reaction time was down, almost twice as fast as before. And when I measured my skin, I found it was stronger than ever. Now it took a very sharp knife to cut me, and I clotted rapidly. I expected my healing rate was probably doubled as well.

I needed a much bigger breakfast than usual, and I suspected that overall I took more resources to keep alive than it took to support a normal person. I could see where I would be at a serious disadvantage in a time when food was scarce. On the other hand, any breeder pair I protected was going to have one hell of a lot better chance of surviving to have more babies.

I no longer had any sex organs.

So far as I could tell, I had no uterus, no ovaries, no eggs, no fallopian tubes. Also, no testes or penis or anything male either. I was a perfect androgyne, neither male nor female.

I was something new. More specifically, I was something very old.

Sandy spent the day in bed. She started having contractions just after midnight. They were still twenty minutes apart, but she was in true labor now. I called the doctor and she said to wait until they were ten minutes apart, then to call her first, then go straight to the hospital.

I was restless as we waited, and I kept going back to the museum in my mind. I went over the encounter again and again. Gradually the emotion leaked out of it, and I began to treat it as a training exercise.

It would never happen again. Nothing would ever hurt Sandy again.

Sandy went to fifteen minutes between contractions, then stuck at around twelve. I checked her every half hour, and let her suck on ice chips, but nothing more. She threw up once, bile and stomach fluid and a little of the soup we had for supper. I held her forehead until she finished, then took away the bucket. She collapsed back in bed, propped up on her pillows.

"You're too good to me, Benita," she said.

"Do you want to go to the hospital now?" I asked. She shrugged.

"My contractions are still too far apart. I've got hours of labor left. If I'm going to wait, I'd rather wait here at home, in my own bed, with just the two of us," she said, and smiled wanly. . . .

I touched the swollen belly, the gesture respectful and gentle. Sandy smiled at me again, her face drawn and sweaty and held my hand for a moment. I kissed her chastely on the forehead and tucked the blanket a little more tightly around her.

She watched old movies on the video and I made myself two gigantic sandwiches and ate them in the kitchen. I felt more alert and alive than I could ever remember. And the last thing I wanted to do was to waste that feeling watching *Rebecca* for the fifteenth time.

"Benita? Benita?" Sandy called, her voice strained and tight. Suddenly, I was halfway up the stairs with a speed I never had before. Sandy leaned on the edge of the bed, her feet swung over to the side, her hands wrapped around her swollen belly.

"It's time," she said. "Let's go have a baby."

T=Now. And Now is Forever.

I stood next to Sandy in the delivery room. She half reclined on the table, her legs spread wide, and gripped my hand until her knuckles were white.

"Push! I said *push*, damn it! Again! Again! One more time, and this time really bear down."

Even now, with all the changes, with all my new strength and tougher skin, I still felt Sandy's hand grind my bones together.

"Got him!"

And she collapsed back against the table, while the doctor gently spanked the baby. It gave a startled gasp, and then howled like hell.

"Your son," the doctor said, and

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smiled, and placed the child, still connected by the umbilical cord, into Sandy's arms. I leaned close, my head next to her's, and stared in awe at the red-faced squalling bundle.

"He's beautiful," I whispered.

I don't know how Sandy heard me over the baby and the noise of the delivery team as they clamped the cord and delivered the afterbirth, but she did. She turned the baby to face me more closely.

"Our baby," she said softly. "He needs both of us, to guard and protect him."

I looked at her and nodded.

"His name is David," I said to her. She smiled, and nodded.

I wrote earlier that I was changed, now. That I was neither male nor female. That I was something new.

I was wrong.

I am something very, very old. Something that was gone for many millions of years. Something that our breeding pairs have missed for a long, long time.

In the Permian, my kind knew duty. And love.

And I'm back. ■

IN TIMES TO COME

The lead novella for our June issue, ably illustrated by the author himself, is Wolf Read's "The Trees of Verità." These trees dwarf anything on Earth, going well beyond the size of sequoias or the complexity of banyans—but that's not the most special thing about them. They appear to have something which humans have long and deeply craved, but never really expected; and they just might provide the key to humans' getting it for themselves. Or so, at least, it seems; and therein lies a trap. . . .

Geoffrey A. Landis, a regular both in *Analog* and at NASA, provides our science fact article, "Onward to the Pole!," wherein he reveals why a pole is an especially appealing destination for a Mars expedition. We'll also have fiction by such authors as Rick Shelley and Bill Johnson, and last but by no means least, Part II of Catherine Asaro's novel *The Quantum Rose*.

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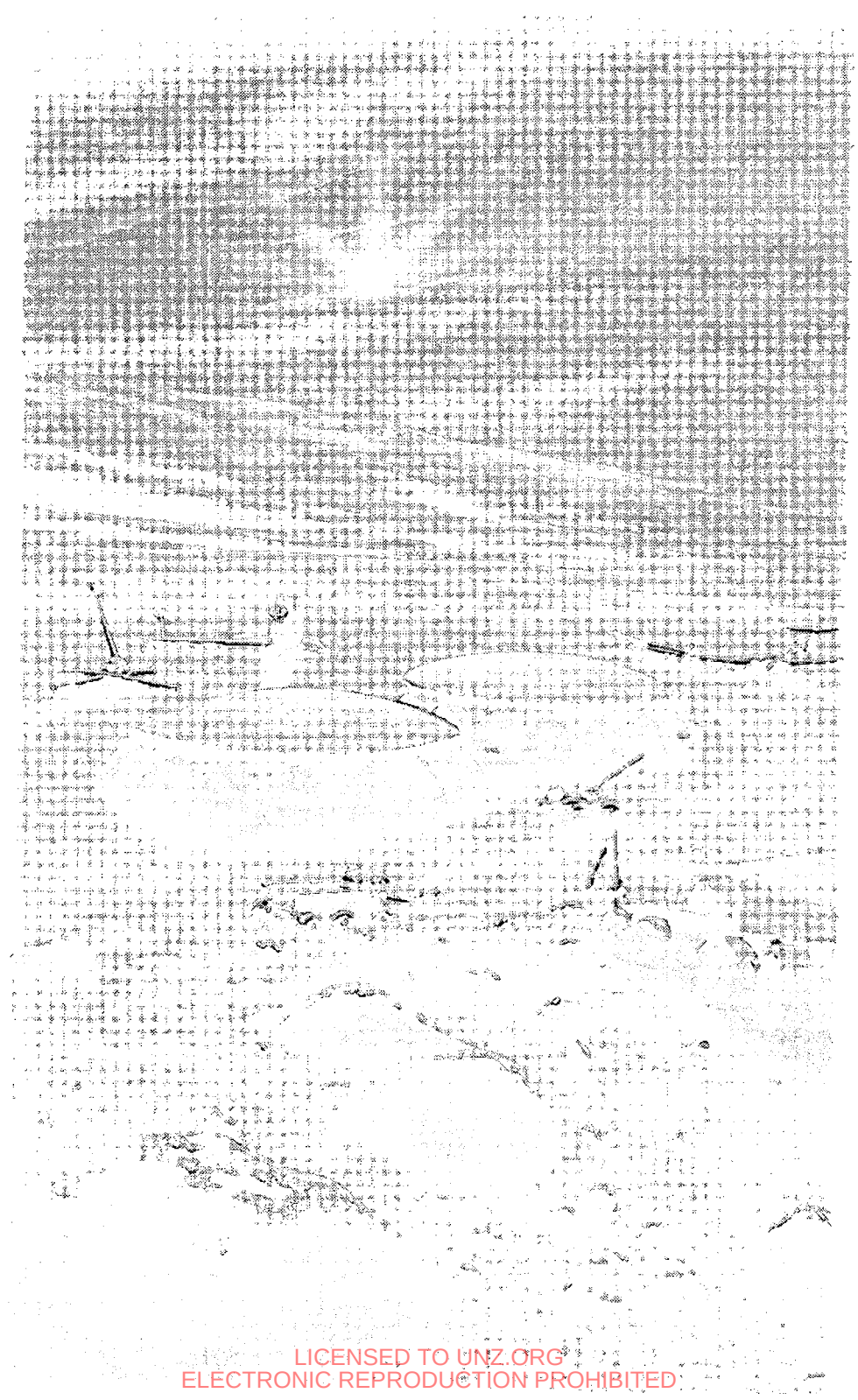

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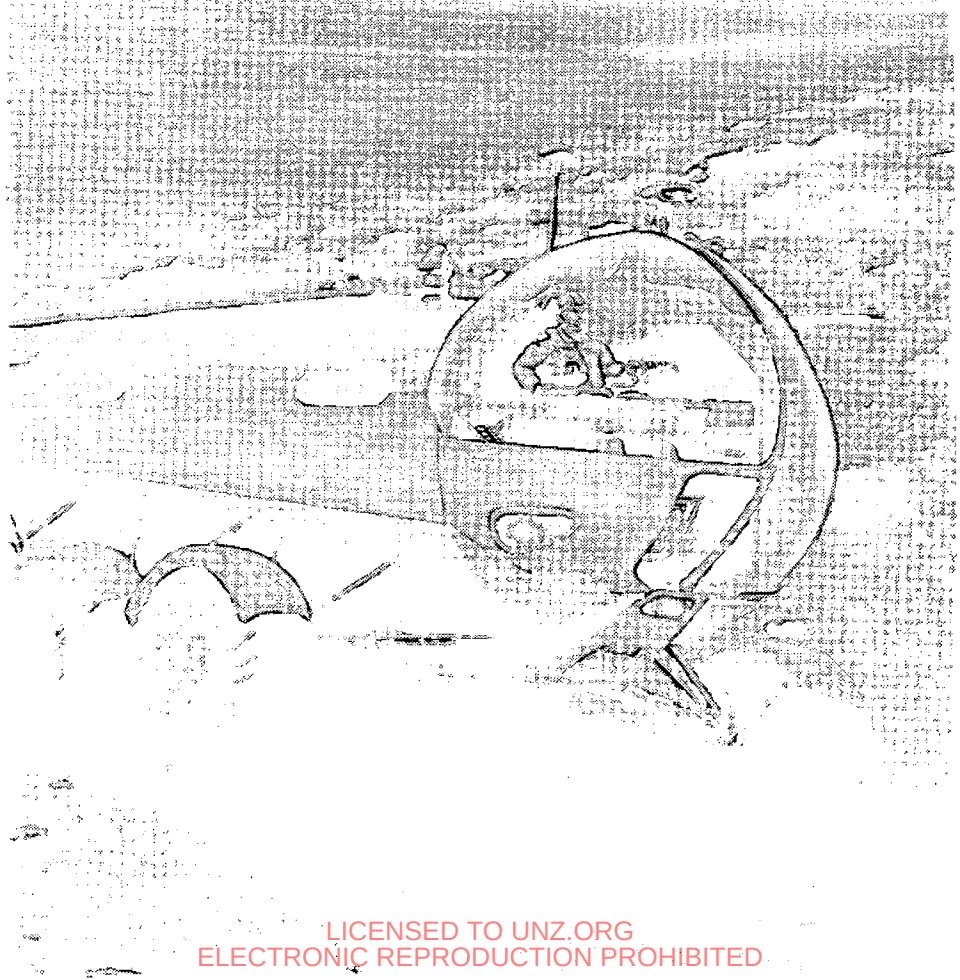
Ben Bova

RED SKY AT MORNING

Anticipating emergency needs is a desirable ability—but the best teacher of what you really need is a real emergency!

Illustration by Randy Asplund-Faith



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The gentle winds wafted ghostlike across the rust red desert of Mars as they had for uncounted millions of years, hardly stirring the dusty ground. Across plains pitted by meteor craters they swirled, along deep yawning gorges, around the flanks of massive shield volcanoes and across fields of rocks strewn like the scattered toys of careless children.

Across the entire planet, nothing had changed in ages. Except for one place, on the western end of Lunae Planum, where the rocky ground begins to rise toward the great Tharsis bulge. There stood a strangely incongruous structure, a pair of plastic domes, surrounded by cleat treads of tractors and boot prints of human explorers, visitors from distant Earth.

Morning sunlight streamed through the main dome's lower sides. Above the transparent layer the dome was opaque, reinforced with foamgel to absorb the impact of stray meteoroids. After sunset even the transparent layer was darkened by a polarizing electric current, to keep the dome's interior heat from leaking out into the frigid Martian night. The frail strangers from the blue planet could not survive in the cold of the red planet's night.

"It will be lonesome around here," Stacy Dezhurova said over breakfast.

"We won't be gone that long," Dex Trumball said. "Four weeks, tops."

They were sitting around the long table in the galley: Dezhurova, Trumball, Jamie Waterman and Possum Craig. The Russian cosmonaut seemed almost melancholy, which surprised Jamie. Usually Stacy was impassive, businesslike. She was a solid, thickset woman with a broad, chunky face and a sandy-blonde pageboy that looked as if somebody had put a bowl over her head and chopped away.

"The dome will be quiet," she said, turning her glance from Trumball to Craig. "First Fuchida and Tomas fly out to the volcano, now you two are leaving us."

Dex grinned at her. "Yeah, but when we come back we'll have the old Pathfinder hardware with us. And the little Sojourner wagon, too."

Dex was handsome, with movie-star looks: dark curly hair, lively blue-green eyes the color of a tropical sea, and a crooked little grin that hovered between self-confidence and cockiness.

Craig was just the opposite: a jowly, shaggy, good-natured bear of a former oil-field geologist with a prominent snoot and permanent five-o'clock shadow.

Jamie inwardly worried that they were biting off more than they could chew. Dex had insisted on adding this long excursion to the mission. For what? Jamie asked himself. So that they could retrieve the Pathfinder/Sojourner spacecraft and auction them off to a museum or private collector. The money people who funded the Second Martian Expedition backed the idea whole-heartedly, of course. Including Dex's father, who was the biggest money guy of them all.

Despite Jamie's misgivings, the expedition controllers had OK'ed Dex's plan. So now he and Craig were off on a four-week-long jaunt to Ares Vallis in the old rover they had recovered from the first expedition and refurbished with spare parts from their stores.

And they had to launch their backup fuel generator all the way out to Xanthe Terra, to the halfway point in Dex's excursion, so that he and Craig could refuel their rover on the way out and the way back again.

It's not good planning, Jamie told himself. There's no margin for error. It's not smart, not safe. And it certainly isn't good science. Dex is stealing four weeks from his geology work and Craig's . . . for what? To make money. To get glory for himself.

But there was nothing he could do about it. He had objected as strongly as he knew how. His objections were noted back on Earth. And overruled.

So the morning's work would be: First, launch the generator and land it

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safely in Xanthe. Second, get Dex and Craig off on their jaunt—if the generator lands safely where it's supposed to.

A big morning.

Everyone crowded into the comm center as Dezhurova made the final preparations to launch the generator. Everyone except Jamie, who suited up and went through the airlock to watch the launch with his own eyes.

He walked alone to the crest of the little ridge formed by the rim of an ancient crater. From this vantage he could see the rocket booster standing on the horizon, the fuel generator still sitting at its top, as always. But now its propellant tanks were filled with liquified methane and oxygen. Jamie could see a wisp of white vapor wafting from a vent halfway up the rocket's cylindrical body. But there was no condensation frost on the booster's skin; there simply was not enough moisture in the Martian air for that.

In his helmet earphones Jamie heard the automated countdown ticking off, "Four . . . three . . . two . . . one . . ."

A flash of light burst from the rocket's base and the booster was immediately lost in a dirty pink-gray cloud of vapor and dust. For a heartbeat Jamie thought it had exploded, but then the booster rose up through the cloud and he heard—even through his helmet—the growling roar of the rocket engines.

Higher and higher the rocket rose, swifter and swifter into the bright pink sky. Jamie bent back as far as his hard suit would allow, saw the rocket dwindle to a speck in the sky. And then it was lost to sight.

By the time he had come back through the airlock and taken off his suit, there were whoops and cheers coming from the comm center. Leaving the suit to be vacuumed later, Jamie hurried to join the crowd.

"Down . . . the . . . pipe," Dezhurova was saying. She sat hunched before a display screen, her thick-fingered hands poised over the keyboard like a concert pianist's ready to play.

But she did not touch the keys. She did not have to. The screen showed a plot of the rocket's planned descent trajectory in red, next to a plot in green of its actual course. The two lines overlapped almost completely.

"The wind is stiffer than we expected," Dezhurova said. "But *nyét problemy.*"

Vijay Shektar, the expedition doctor, was sitting beside Stacy, filling in as her assistant. The others were clustered behind the two women, huddled together like a shorthanded football team.

"Fifteen seconds to touchdown," Vijay sang out.

"Looks good," Dezhurova said tightly.

"Lookin' *great*," shouted Possum Craig.

"Ten . . . nine . . ."

"I told you the spot was clear of boulders," Dex Trumball said, to no one in particular.

Jamie saw that he was standing behind Vijay, his hand on her shoulder. He felt his nostrils flare with barely-suppressed anger.

And he remembered what Vijay had told him the first night after they had landed, her almond eyes so serious, so lustrous. She always disconcerted Jamie, with her exotic dark Hindu looks and flippant, almost caustic Aussie accent. That night she had rattled him even more than usual.

"Dex is an alpha male, y'know. Just like you. You're both natural leaders. You both *have to* be top dog. It's a prescription for trouble. Maybe disaster."

Maybe disaster, Jamie thought as the countdown ticked off. Maybe I'm sending the two of them off to their deaths. And it would be my fault if it happens; not the money people who made the decision to let them go, not the expedition controllers who agreed to do it—my fault.

"Four . . . three . . . two . . . touchdown!" Vijay announced.

"She is down, safe and sound," said Dezhurova. She swivelled her chair

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around and swept her headset off with a flourish.

"We're set for the run out to the Sagan site," Dex crowed, beaming with satisfaction.

"Not till we check out the fuel generator, partner," Craig warned. "That contraption's gotta be perkin' right before we go traipsin' all the way out there."

"Yeah, sure," Dex replied, his triumphant grin shrinking only a little.

Within an hour they had all the data they needed. The drill had hit permafrost and the fuel generator was working just as if it had never been moved, already replenishing the booster's propellant tanks.

Trumball and Craig were suiting up; Jamie and Vijay were checking them out: Jamie with Possum, Vijay with Dex.

"Hope we can get the VR rig working right," Dex said as he lifted his helmet from its shelf. Even encased in the bulky suit he radiated excitement, practically quivering, like a kid on Christmas morning.

"Well, I'll finally get enough time to really tear her innards apart and see what th' hell's wrong with her," Craig said.

Their plan was for Possum to work on the faulty VR rig during the long hours of the trek when he was not driving the rover.

Jamie was helping him put on his suit's backpack. Craig backed into it and Jamie clicked the connecting latches shut. Then Possum stepped away from the rack on which the backpack had rested.

"Electrical connects OK?" Jamie asked.

Craig peered at the display panel on his right wrist. "All green," he reported.

"Good." Jamie plugged the air hose into Craig's neck ring.

"You're ready for your radio check," Vijay said to Trumball.

Dex slid his visor down and sealed it. Jamie could hear his muffled voice calling to Stacy Dezhurova, who was manning the communications center, as usual. After a moment he slid the visor up again and made a thumb-up signal.

"Radio OK."

It took Craig another few minutes to get his suit sealed up and check out its radio. Trumball paced up and down restlessly. In the suit and thick-soled boots he reminded Jamie of Frankenstein's monster waiting impatiently for a bus.

"We're all set," Dex said once Craig's radio check was done. He turned toward the airlock hatch.

"Hold on a second," Jamie said.

Trumball stopped, but did not turn back to face Jamie. Craig did.

"I know you've checked out the rover from here to hell and back," Jamie said, "but I want you to remember that it's an old piece of hardware and it's been sitting out in the cold for six years."

"We know that," Trumball said to the airlock hatch.

"The first sign of trouble, I want you to turn back," Jamie instructed. "Do you understand me? The hardware you're setting out to retrieve isn't worth a man's life, no matter how much money it might bring in on Earth."

"Sure," Dex said impatiently.

"Don't worry, I ain't no hero," Craig added.

Jamie took in a deep breath. "Possum, I'm putting you in charge of this excursion. You're the boss. Dex, you follow his orders at all times. Understand?"

Now Trumball turned toward Jamie, slowly, ponderously in the cumbersome hard suit.

"What kind of bullshit is this?" he asked, his voice low and even.

"It's chain-of-command, Dex. Possum's older and he's had a lot more experience living out in the field than either one of us has. He's in charge. Any time you two don't agree on something, Possum is the winner."

Trumball's face went through a whole skein of emotions within the flash of a moment. Jamie waited for an explosion.

But then Dex broke into a boyish grin. "OK, chief. Possum's the medicine man

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and I'm just a lowly brave. I can live with that."

"Good," Jamie said, refusing to let Trumball see how much he hated Dex's sneering at his Navaho heritage.

Gesturing toward the hatch with a gloved hand, Trumball said to Craig, "OK, boss, I guess you should go through the airlock first."

Craig glanced at Jamie, then pulled down his visor and clomped to the hatch.

Vijay said, "Good luck."

"Yeah, right," answered Trumball. Craig waved silently as he stepped over the sill of the open hatch.

The three of them stood in uncomfortable silence while the airlock cycled. When its panel light turned green again, Trumball opened the hatch and stepped in.

Before closing it, though, he turned back to Jamie and Vijay.

"By the way, Jamie, I didn't get a chance to say so long to my father. Would you give him a buzz and tell him I'm on my way?"

"Certainly," Jamie said, surprised at the sweet reasonableness in Trumball's voice.

The hatch slid shut. Jamie started toward the comm center, Shektar walking alongside him.

Vijay asked, "Did you have to do that?"

"What?" Jamie asked.

"Humiliate him."

"Humiliate?" Jamie felt a pang, but it wasn't surprise. It was disappointment that Vijay saw his decision this way.

"Making him officially subordinate to Possum," she went on. "That's belittling him."

Striding along the partitions that marked off the team's sleeping cubicles, Jamie said, "I didn't do it *to* Dex, I did it *for* Possum."

"Really?"

"Dex would try to steamroller Possum whenever they had a difference of opinion. This way, Possum's got the clout to make the final decisions. That might save both their lives."

"Really?" she said again.

"Yes, really."

He looked down at her. Her expression showed a great deal of disbelief.

By the time they reached the comm center, Craig and Trumball had climbed into the rover and started up its electrical generator.

"The boss is going to let me drive," Dex exclaimed, his radio voice brimming with mock delight. "Goodie, goodie."

Stacy Dezhurova went down the rover checklist with him, then cleared them for departure.

"We're off to see the Wizard," Dex said. "Be back in a month or so."

In Dezhurova's display screen Jamie saw the rover shudder to life, then lurch into motion. It rolled forward slowly at first, then turned in a quarter-circle and headed off toward the east.

"Oh, Jamie," Trumball called as they trundled toward the horizon, "please don't forget to call my Dad, OK?"

"You can call him yourself, right now," Jamie responded.

"No, I want to concentrate on my driving. You do it for me, huh? Please?"

Jamie said, "Sure. I'll send him a message right away."

"Thanks a lot, chief."

Jamie went to his quarters and sent a brief message Earthward, telling Darryl C. Trumball that his son was on his way to Ares Vallis and wanted him to know that everything was going well.

As he looked up from his laptop screen, he saw Stacy Dezhurova at his open doorway. She looked even moodier than she had at breakfast, almost worried.

"What's the matter, Stacy?"

The cosmonaut stepped into Jamie's cubicle but didn't take the empty desk chair. She remained standing.

With a shake of her head that made her pageboy flutter, she answered, "I can't help thinking that I should be out in that rover with them."

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Jamie shut down his computer and closed its lid. "Stacy, we went over that a couple of hundred times. You can't be everyplace."

"The safety regulations say an astronaut must be on every excursion."

"I know, but this trek of Dex's is an extra task that we didn't plan on."

"Still . . ."

"Sit down," Jamie said, pointing to the desk chair. He immediately felt silly; there was no other chair in the cubicle.

She sat heavily, like a tired old woman, and Jamie leaned toward her from the edge of his bunk. "We just don't have enough people to send you along with them. You know that."

"Yes."

"And Possum's about as good as they come—for a guy who's not an astronaut."

"Yes," she said again.

"They'll be OK."

"But if something happens," she said, "I will feel responsible. It is my job to go out with the scientists and make certain they don't get themselves killed."

Jamie sat up straighter. "If something happens, it's my responsibility, not yours. I made the decision, Stacy."

"I know, but . . ." Her voice trailed off.

"Look: Tomas had to go with Mitsuo, there was no way around that. We need you here at the base. We don't have any other astronauts! What do you expect me to do, clone you?"

She let a small grin break her dour expression. "I understand. But I don't like it."

"They'll be OK. Possum's no daredevil."

"I suppose so."

Is she sore because Tomas got to fly to Olympus Mons instead of her? Jamie wondered. But she knew that's how it would be. God, we made that decision before we left Earth.

All during the weeks that Rodriguez had been test-flying the rocketplane, taking it out on jaunts that started with a simple circle around their base camp and gradually extended as far as Olympus Mons and back again, never once did Stacy ask to fly the plane. Never once did she show that she was unhappy that Tomas would be the pilot while she "flew" the comm console here at the base.

Only now was she showing how unhappy it made her. Astronauts are fliers, Jamie realized. She's a pilot and she's not being allowed to fly. He remembered how he had felt when it looked as if he would not be selected for the expedition to Mars.

Leaning closer to her, Jamie said, "Stacy, the Navaho teach that each person has to find the right path for his life. Or hers. I'm sorry that your path is keeping you on the ground while Tomas gets to fly. But there'll be other flights, other missions. You'll get into the air before we leave Mars, I promise you."

She brightened only slightly. "I know. I am being selfish. But still . . . damn! I wish it was me."

"You're too important to us right now to risk on an excursion. We need you here, Stacy. I need you here."

Dezhurova blinked with surprise. "You do?"

"I do," Jamie said.

"I didn't think of it that way."

"Find the right path, Stacy. Find the balance that brings beauty to your life."

"That is the Navaho way, eh?"

"It's the way that works."

Dossier: Anastasia Dezhurova

It was the Americans who called her Stacy. Her father's pet name for her was Nastasia.

Her father was a rocket engineer, a hard-working, sober, humorless man whose work took him away from their Moscow apartment for long months at a time. He travelled mostly to the mammoth launch facility in the dreary dust-brown desert of Kazakhstan and returned home tired and sour, but always with a doll or some other present for his baby daughter. Nastasia was his one joy in life.

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Anastasia's mother was a concert cellist who played in the Moscow symphony, a bright and intelligent woman who learned very early in her marriage that life was more enjoyable when her husband was a thousand kilometers away. She could give parties in their apartment then, people would laugh and play music. Often one of the men would remain the night.

As Nastasia grew into awareness and understanding, her mother swore her to secrecy. "We don't want to hurt your father's feelings," she would tell her ten-year-old daughter. Later, when Nastasia was a teenager, her mother would say, "And do you think he remains faithful during all those months he's away? Men are not like that."

Nastasia discovered what men are like while she was in secondary school. One of the male students invited her to a party. On the way home, he stopped the car (his father's) and began to maul her. When Nastasia resisted, he tore her clothing and raped her.

Her mother cried with her and then called the police. The investigators made Nastasia feel as if she had committed the crime, not the boy. Her attacker was not punished and she was stigmatized. Even her father turned against her, saying that she must have given the boy the impression she was available.

When she was selected for the technical university in Novosibersk she left Moscow willingly, gladly, and buried herself in her studies. She avoided all socializing with men, and found that love and warmth and safety could be had with other women.

She also found that she was very bright, and very capable. She began to delight in beating men in areas where they thought they were supreme. She learned to fly and went on to become a cosmonaut: not merely a cosmonaut but the first woman cosmonaut to command an orbital team of twelve men; the first woman cosmonaut to set a new endurance record for months spent aboard a space station; the first woman cosmonaut to go to Mars.

The Second Mars Expedition included two small tractors for hauling heavy loads and two larger, segmented rover vehicles for overland traverses. The rovers were externally the same as those used in the first expedition: each was a trio of cylindrical aluminum modules, mounted on springy, loose-jointed wheels that could crawl over fair-sized rocks without upsetting the vehicle. They represented a considerable financial saving for the expedition: the cost of developing and testing them had already been absorbed by the first expedition. The second expedition merely had to buy two of them off the shelf.

One of the cylindrical modules was the fuel tank, big enough to keep the vehicle out in the field for two weeks or more. The middle segment usually held equipment and supplies, although it could be modified and pressurized to serve as a small mobile laboratory if necessary. The front segment, largest of the three, was pressurized like a spacecraft so people could live in it in their shirtsleeves. There was an airlock at its rear, where it linked with the second module. Its front end was a bulbous transparent canopy, which made the entire assembly look something like a giant metallic caterpillar.

Each rover was designed to carry four in reasonable comfort, although the entire complement of eight explorers could be squeezed into one in an emergency.

The rover that Craig and Trumball were using, however, was an old one, left abandoned by the first expedition after it had sunk into a crater filled with treacherous dust. At Dex's insistence, they had found the rover, towed it back to the base camp, and refurbished it for this trek to the Sagan site at Ares Vallis.

* * *

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It was already night on the broad rolling plain of Lunae Planum, yet Possum Craig was still driving the old rover—cautiously, at a mere ten kilometers per hour. He and Dex Trumball had agreed that they could mooch out a little extra mileage after sunset, before they stopped for the night.

Trumball had the radio set to the general comm frequency, so they heard Rodriguez's and Fuchida's landing at Olympus Mons at the same time the four in the base camp did.

"Those two poor bastards gotta live in their suits until they get back to th' dome," Craig said.

"Look on the bright side, Wiley. They get to test the FES." Dex had bestowed the nickname Wiley J. Coyote on Craig during the five-month-long flight from Earth, for the older man's nearly mystical ability to fix any kind of machinery.

The hard suits had a special fitting that was supposed to make an airtight connection to the chemical toilet seat. The engineers called it the Fecal Elimination System.

"The ol' trapdoor," Craig muttered. "I bet they wind up usin' Kaopectate."

"Or getting hemorrhoids."

Craig whooped with laughter.

Sitting beside him in the cockpit, Dex added with a grin, "While we've got all the comforts of home."

Craig made a thoughtful face. "For an old clunker, this travelin' machine is doin' purty well. No complaints."

"Not yet."

Dex had spent most of the day in his hard suit. They had stopped the rover every hundred klicks for him to go outside and plant geology/meteorology beacons. Now he sat relaxed in his coveralls, watching the scant slice of ground illuminated by the rover's headlights.

"You could goose her up to twenty," Dex prodded.

"Yeah, and I could slide 'er into a crater before we had time to stop or turn away," Craig shot back. He tapped a forefinger on the digital clock display. "Time to call it a day, anyway."

"You tired already?"

"Nope, and I don't want to drive when I am tired."

"I could drive for a while," said Dex.

Pressing gently on the brake pedals, Craig said, "Let's just call it a day, buddy. We've made good time. Enough is enough."

Trumball seemed to think it over for a moment, then pulled himself out of the cockpit chair. "OK. You're the boss."

Craig laughed. "Shore I am."

"Now, what's that supposed to mean?" Trumball asked over his shoulder as he headed back to the minuscule galley.

Craig slid the plastic heat-retaining screen across the windshield, then got up and stretched so hard that Dex could hear his tendons pop.

"It means that I'm th' boss long's you want to be agreeable."

"I'm agreeable," Dex said.

"Then ever'thing's fine and dandy."

Sliding one of the prepackaged meals from its freezer tray, Trumball said to the older man, "No, seriously, Wiley. Jamie put you in charge. I've got no bitch with that."

Still stretching, his hands scraping the curved overhead, Craig said, "OK. Fine."

"Something bugging you?"

"Naw. Forget it."

As he put the meal tray into the microwave cooker, Dex said, "Hey, come on, Wiley. It's just you and me out here. If something's wrong, tell me about it."

Craig made a face somewhere between annoyed and sheepish. "Well, it's kinda silly, I guess."

"What is it, for chrissakes?"

With a tired puff of breath, Craig sank onto his bunk.

"Well, I'm kinda pissed about bein' a second-class citizen around here."

Trumball stared at him in amazement. "Second-class citizen?"

"Yeah, you know—they all think I'm

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nothin' more'n a repairman, for shit's sake."

"Well—"

"I'm a scientist, just like you and the rest of y'all," Craig grumbled. "Maybe I didn't get my degree from a big-name school, and maybe I've spent most of my time workin' for oil companies . . ." he pronounced *oil* as *awl* ". . . but I was smart enough to get picked over a lotta guys with fancier pedigrees."

"Sure you are."

"That Fuchida. Damned Jap's so uptight I think if he sneezed he'd come apart. Looks at me like I'm a servant or something."

"That's just his way."

"And the women! They act like I'm a grandfather or somethin'. Hell, I'm younger'n Jamie. I'm younger than Stacy is, did you know that?"

For the first time, Dex Trumball understood that Craig was hurting. And vulnerable. This jowly, shaggy, good-natured bear of a man with the prominent snoot and permanent five-o'clock shadow wants to be treated with some respect. That makes him usable, Dex realized.

"Listen, Wiley," Dex began, "I didn't know that we were hurting your feelings."

"Not you, so much. It's the rest of 'em. They think I'm just here to be their bleepin' repairman. 'Least you call me Wiley. Never did like bein' called Possum. My name's Peter J. Craig."

The microwave oven chimed. Dex ignored it and sat on his own bunk, opposite Craig's. "I'll get them to call you Wiley, then. Or Peter, if you prefer."

"Wiley is fine."

A smile crept across Trumball's face. "OK, then. It's going to be Wiley from now on. I'll make certain that Jamie and the others get the word."

Looking embarrassed, Craig mumbled, "Kinda silly, ain't it."

"No, no," Dex said. "If Jamie and the others are bothering you, you've got a right to complain about it."

To himself Trumball thought, If and when we get to a place where I've got to out-gun Jamie, I'll need Wiley on my side. Wiley, and as many of the others as I can round up.

DOSSIER: C. DEXTER TRUMBALL

No matter how well he did, no matter what he accomplished, Dex Trumball could never satisfy his coldly indifferent father.

Darryl C. Trumball was a self-made man, he firmly proclaimed to anyone and everyone. One of Dex's firmest memories was his father cornering a U.S. Senator at a house party and tapping him on the shoulder with each and every word as he declared with quiet insistence, "I started with nothing but my bare hands and my brain, and I built a fortune for myself."

In truth, the old man had started with a meager inheritance: a decrepit auto body shop that was on the verge of bankruptcy when Dex's grandfather died of a massive stroke in the middle of his fourth beer at the neighborhood bar.

Dex had been just a baby then, an only child. His mother was pretty, frail, and ineffectual; totally unable to stand up to her hard-driving husband. Dex's father, blade-slim, fast and agile, had attended Holy Cross on a track scholarship. He never graduated; he had to take over the family business instead. His dream of going to the Boston College Law School, as he had been promised, was shattered, leaving him bitter and resentful.

And filled with an icy, relentless energy.

Darryl C. Trumball quickly learned that business depends on politics. Although the body shop was practically worthless, the land on which it stood could become extremely valuable if it could be converted to upscale condominiums for the white-collar types who worked in Boston's financial district. He pushed feverishly to get the old neighborhood rezoned, then sold the

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shop and his mother's house for a sizable sum.

By the time Dex was ready for college, his father was very wealthy and known in the financial community for his cold-blooded ruthlessness. Money was important to him, and he spent every waking hour striving to increase his net worth. When Dex expressed an interest in science, the elder Trumball snorted disdainfully:

"You'll never be able to support yourself that way! Why, when I was your age I was taking care of your grandmother, your two aunts, your mother and you."

Dex listened obediently and registered anyway for physics at Yale. His high-school grades (and his father's money) were good enough to be acceptable to Harvard and half a dozen other Ivy League schools, but Dex decided on Yale. New Haven was close enough to Boston for him to get home easily, yet far away enough for him to be free of his father's chilling presence.

Dex had always found school to be ridiculously easy. Where others pored over textbooks and sweated out exams, Dex breezed through with a near-photographic memory and a clever ability to tell his teachers exactly what they wanted to hear. His relationships with his peers were much the same: they did what he wanted, almost always. Dex got the brilliant ideas and his friends got into trouble carrying them out. Yet they never complained; they admired his dash and felt grateful when he noticed them at all.

Sex was equally easy for him, even on campuses electrified by charges of harassment. Dex had his pick of the women: the more intelligent they were, the more they seemed to bask in the temporary sunshine of his affection. And they never complained afterward.

Physics was not for Dex, but he found himself drawn to geophysics: the study of the Earth, its interior and its atmosphere. His grades were well-nigh perfect. He was a campus leader in everything from the school television station to the tennis team. Yet his father was never pleased.

"An educated bum, that's what you are," his father taunted. "I'll have to support you all my life and keep on supporting you even after I'm gone."

Which suited Dex just fine. But deep within, he longed to hear one approving word from his father. He ached to have the callous old man smile at him.

His life changed forever at a planetarium show. Dex liked to take his dates to the planetarium. It was cheap, it impressed young women with his seriousness and intelligence, and it was the darkest place in town. Very romantic, really, sitting in the back row with the splendors of the heavens spangled above.

One particular show was about the planet Mars. After several failures, an automated spacecraft had successfully returned actual samples of Martian rocks and soil to a laboratory in orbit around the Earth. Now there was talk of sending human explorers there. Suddenly Dex stopped fondling the young woman who had accompanied him and sat up straight in his chair.

"There's more than one planet to study!" he said aloud, eliciting a chorus of shushing hisses from around him, and the utter humiliation of his date.

Dex spent that summer at the University of Nevada, taking a special course in geology. The next summer he went to a seminar on planetary geology in Berkeley.

By the time the first expedition had returned from Mars, triumphantly bearing samples of living Martian organisms, Dex had degrees from Yale and Berkeley. He went to the struggling Moonbase settlement for six months to do field work on the massive meteorites that lay buried deep beneath Mare Nubium and Mare Imbrium.

Much to his father's dismay.

"I give the government fortunes of

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tax money for this space stuff," the old man complained bitterly. "What damned good is it?"

Dex's father was a real-estate tycoon now, with long fingers in several New England-based banks and business interests in Europe, Asia and Latin America. He kept in touch with his far-flung associates through satellite-relayed electronic links and even leased space in an orbital factory that manufactured ultrapure pharmaceuticals.

Dex smiled brightly for his father. "Don't be a flathead, Dad. I want to be on the next expedition to Mars."

His father stared at him coldly. "When are you going to start bringing some money in to this family, instead of spending it like it's water?"

Challenged, wanting to please his father and win his approval for once, Dex blurted, "We could make money from Mars."

His father was neither surprised nor stopped by the younger man's assertion. He simply asked one question: "How?"

That was when Dex began planning an expedition to Mars that would be funded by private donors. To be sure, a good deal of taxpayers' money went into the pot. But once Dex enlisted the interest and drive of his profit-oriented father, funding for the Second Martian Expedition came mainly from private sources.

Dex was determined to make the expedition profitable. He wanted his father's praise, just once. Then he could tell the old man to go bust a blood vessel and drop dead.

Jamie spent nearly an hour after dinner talking with Rodriguez and Fuchida out atop Olympus Mons. They were spending the night in their seats in the plane's cockpit. Like trying to sleep in an airliner, Jamie thought. Tourist class. In the hard suits. He did not envy them their creature comforts.

Still in the comm center, he scrolled through the messages that had accumulated through the long, eventful, draining day. It took more than another hour to deal with them: everything from a request for more VR sessions from the International Council of Science Teachers to a reminder that his mission status report for the week was due in the morning.

One message was from Darryl C. Trumball. Since it was marked "PERSONAL AND CONFIDENTIAL," Jamie saved it, planning to go to his own quarters before he looked at it.

But when he finished all the other messages, he glanced up from the comm screen and saw that the dome was darkened for the night. Suddenly it seemed chilly, as if the frigid cold of the Martian night were seeping through the dome's plastic walls.

No one seemed to be about. No voices, only the background sounds of the machinery and, if he listened carefully enough, the soft sighing of the night wind outside.

So he opened Trumball's personal message.

Darryl C. Trumball's eyes were blazing, his skull-like face grim as death.

"Who in the hell gave you the authority to send my son out on this excursion to the Sagan site?" he began, furious, with no preamble.

"Goddammit to hell and back, Waterman, I specifically gave orders *not* to allow Dex out on that excursion!"

And so it went, for nearly fifteen blistering minutes. Jamie watched Trumball's angry face, flabbergasted at first, then growing angry.

But as the older man blathered on, Jamie's anger slowly dissolved. Behind Trumball's bluster, he saw a man worried about his son's safety, a man accustomed to power and authority, but totally frustrated now because there was no way he could control the men and women on Mars. No way he could control his own son.

He can't even talk to us face-to-face,

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Jamie knew. All he can do is rant and rave and wait to see if we respond to him.

Trumball finally wound down and finished with, "I want you to know, Waterman, that you can't countermand my orders and get away with it. You'll pay for this! And if anything happens to my son, you'll pay with your goddamned blood!"

The screen went blank. Jamie reran the whole message, then froze Trumball's angry, snarling image at its end.

Leaning back in the squeaking little wheeled chair, Jamie wondered if he should be firm or conciliatory. A soft answer may turneth away wrath, he thought, but Trumball won't be diverted that easily.

There's more involved here than a squabble between Trumball and me, he told himself. That old man is a primary force behind the funding for this expedition—and the next. If you want a smooth road for the next expedition, Jamie told himself, you've got to keep Trumball on the team.

Yet as he stared at the coldly furious image on the screen, anger simmered anew within Jamie. Trumball has no right to scream at me or anybody else like that. If he's sore at his son he should take it out on Dex, not me. And if I give him the impression that he can push me around, he'll start making more demands. He's a bully; the more I give in to him the more he'll take.

What's the best path, grandfather? How can I do this without causing more pain?

He took a deep breath, then pressed the key that activated the computer's tiny camera. Jamie saw its red eye come on, just atop Trumball's stilled image on the screen.

"Mr. Trumball," he began slowly, "I can understand your concern for your son's safety. I had no idea you sent a message that Dex was not to go on the excursion to pick up the Pathfinder hardware. There was no such message addressed to me. And with all due respect, sir, you are not in command of this expedition. I am. You are not in a position to give orders."

Jamie looked directly into the camera's unblinking red eye and continued, "Neither Dex nor anyone else here will receive any special privileges. The idea for picking up Pathfinder was his, and he certainly wanted to go out on the excursion. Even had I known of your wishes, I'm afraid I would have had to go against them. This is Dex's job, and I'm sure he'll do it without trouble.

"He's got the best man we have along with him: Dr. Craig. If they run into any difficulties, they will return to base. I had—I have, no intention of taking foolish risks with anyone's life."

Unconsciously hunching closer to the camera, Jamie concluded, "I know that you helped to raise most of the money for this expedition, and we're all very grateful for that. But that doesn't give you the authority to make decisions about our work here. You can go to the ICU and complain to them if you want to. But frankly, I don't see what even they could do for you. We're here, more than a hundred million kilometers from Earth, and we have to make our own decisions.

"I'm sorry this particular decision has you so upset and worried. Maybe when Dex comes back with the Pathfinder and Sojourner you'll feel differently. Good night."

He tapped the keyboard twice: once to turn off the camera, the other to transmit his message to Trumball. Only then did he blank the old man's image from the screen.

"I would've told him to stick it up his arse."

Jamie wheeled around and saw Vijay leaning against the partition doorway, holding a steaming mug in both hands, as if she were trying to warm herself with it.

"How long have you been there?"

She came in and sat down beside him. "I was getting myself a cuppa when I heard Dex's dad ranting."

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She was in her bulky coral-red turtleneck sweater and loose-fitting jeans instead of the usual coveralls, sitting so close to him that Jamie caught the delicate scent of the herbal tea she was drinking, and sensed its warmth.

He said, "The old man must've told Dex he didn't want him going out on this excursion and Dex never informed me about it."

Vijay took a sip from the steaming mug. "Should he have?"

"It would've helped."

"Maybe he was afraid you'd nix the excursion if you knew."

Jamie shook his head. "I couldn't do that. Let somebody like Trumball think he can boss you around and you'll never hear the last of him."

She dipped her chin in agreement. "There is that."

"I just hope nothing happens while he's out there," Jamie said.

"Din't you hope that anyway? Before Trumball's blast, I mean."

"Yeah, sure, but . . . you know what I mean."

"Yes, I suppose I do."

Jamie blurted, "You slept with him, didn't you?"

"With Dex?"

"During the flight." Jamie was shocked that he mentioned it. The words had come out before he realized what he was going to say.

Vijay nodded, her expression fathomless. "Yes. Once."

"Once," he repeated.

With an odd little smile, Vijay said, "You get to know a lot about a man when he's got his pants down."

Jamie ran out of words.

"I told you he was an alpha male," she said. "Same as you are."

He nodded glumly.

"I'm attracted to alpha males."

"So you're attracted to him."

"I was. Now I'm attracted to you."

"Me?"

She broke into a smile. "Do you see anybody else around here?"

Jamie felt off-balance. She's teasing me. She must be teasing.

Placing her mug on the corner of the console desk, Vijay said, "You're attracted to me, aren't you?"

"Um, sure."

She got to her feet and put her hand out to him. "So the only question remaining is, your place or mine?"

Jamie stood up slowly, not certain his legs would support him. "It's not that simple, Vijay."

She planted her hands on her hips. "My god, Jamie, you're as bad as most Aussie blokes!"

"I didn't mean—"

She stepped up to him and slid her arms around his neck. "Don't you ever feel lonely?," she whispered. "Or scared? We're so alone out here. So far from home. Doesn't it ever get to you?"

Her voice wasn't teasing now. He held her tightly and could feel her trembling. Beneath all the flip talk she was tense with anxiety.

"I don't want to be alone tonight, Jamie."

"Neither do I," he admitted at last. "Neither do I."

Pale morning sun slanted through the rover's curved windshield as Dex drove steadily across the rolling, rock-strewn plain. Each pebble and gully cast long early morning shadows. The sunlight looks different here, Dex thought. Weaker, pinker . . . something.

He and Craig had been underway for nearly an hour when Dex saw a red light suddenly glare up from the control panel.

"Hey, Wiley," he called over his shoulder. "We've got a problem here."

Craig shuffled into the cockpit and sat in the right seat, muttering, "What's this 'we,' white man?"

Dex jabbed a finger at the telltale.

"Oh-oh," said Craig.

"That doesn't sound so good, Wiley."

"Fuel cells're discharging. They shouldn't oughta do that."

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"We don't have to stop, do we?"

"Naw," said Craig. "I'll take a look."

He headed for the rear of the rover module. The fuel cells were the backup electrical system, to be used if the solar panels outside were unable to charge up the batteries that ran the rover's systems at night. The fuel cells on this old rover were powered by hydrogen and oxygen, which meant that their "waste" product was drinkable water. The fuel cells on the newer rovers ran on methane and oxygen generated from permafrost water and the Martian atmosphere.

Trumball drove on across the monotonous landscape. "Miles and miles of nothing but miles and miles," he murmured to himself. He knew he should be studying the land with a geologist's professional eye, categorizing the rock formations, watching how the sand dunes built up, checking the density of the rocks scattered everywhere, looking for craters. Instead he simply felt bored.

Precisely at the one-hour mark the timer on the panel chimed.

Dex called back to Craig, "Time to stop and plant a beacon, Wiley."

"Keep goin'," Craig said. "I'll suit up; gotta go outside anyway to check out the damned fuel cells."

Dex kept the rover trundling along while Craig struggled into his hard suit on his own. Once Craig announced he was ready, Dex stopped the vehicle and went back to check the older man's suit and backpack.

"Looks good, Wiley," he said.

"OK," came Craig's voice, muffled by the sealed helmet. "Gimme one of the beacons."

Dex did that, and then started to tug on his own suit. Stupid flathead safety regs, he said to himself as Craig cycled through the airlock and went outside. I've gotta stand here in this tin can like some deadhead just because Wiley's outside. If anything goes wrong, he'll pop back into the airlock; he won't need me to come out and rescue him.

While Dex grumbled to himself he thought briefly about the safety regulation that required a second person to check out his suit. How the hell can you do that when the second man is already outside? he complained silently. He had no intention of going outside anyway, not unless Craig got into some unimaginable difficulty. The morphs who wrote these regulations must be the kind of guys who wear suspenders and a belt, he told himself. Old farts like Jamie.

Dex clomped back to the cockpit and sat awkwardly in the left seat. All the lights on the board were green, except the one for the fuel cells.

"How's it going, Wiley?" he called on the intercom.

"Checkin' these drat-damn fuel cells. Gimme a few minutes."

"Take your time," said Dex.

Sitting there idly, Dex scanned the horizon. Nothing. Dead as Beethoven. Deader. Nothing but rocks and sand and every shade of red the human eye could register. Not a thing moving out there—

He sat up bolt upright, not an easy thing to do in the hard suit. Something *was* moving out there! Just a flicker, off on the horizon, and then it was gone.

Dex went back to the equipment lockers beneath the bunks in the module's midsection. Bending over in the suit was awkward—he had to lower himself to his knees to reach the latches that opened the lockers. Cursing the suit and its gloves, he fumbled through the neatly-ordered sets of tools until he found the electronically-boosted binoculars. Then he hurried back to the cockpit, like some old movie monster trying to gallop.

His helmet visor was up, so Dex could put the binoculars against his eyes to scan the horizon. Nothing. Whatever it was had disappeared, gone away.

Wait! A flicker . . .

Dex adjusted the focus and it came into crisp view. A dust devil. A swirling little eddy of dust, red as a real devil. It would have been called a pillar of fire in the Old Testament, Dex thought, except

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that this one is on Mars, not Israel or Egypt. It occurred to him that there was a region on Mars called Sinai, south of the Grand Canyon.

"You oughta be down there, pal," he murmured as he watched the minicyclone twist and dance across the distant horizon.

As he put the binoculars down Dex remembered that giant dust storms sometimes blanketed Mars almost from pole to pole. Usually during the spring season. He shook his head inside his helmet. It's too late in the season now; we timed the landing so the storms would be over. Besides, there weren't any this year.

Not yet, warned a tiny voice in his head. Spring lasts six months on Mars.

Jamie felt decidedly awkward at breakfast. Usually the team members took their morning meal when they chose to; there was no set time when everyone gathered at the galley each morning. It just happened that when Jamie came out of his quarters, Vijay, Dezhurova, and the English biologist Trudy Hall were already sitting at the table, heads together, chatting busily.

When they saw Jamie approaching their chat stopped. He said "Good morning" to them and got a chorus of the same in return. Then watchful silence as he picked a breakfast package from the freezer. He could feel their eyes on him.

"The strawberries ought to be ready for picking in another few days," he announced to no one in particular.

"Yes, and the tomatoes, too," answered Trudy Hall.

Trudy and Fuchida were the gardeners, although everybody pitched in as needed. The hydroponic garden, in its own plastic dome, was intended not only to supply the bulk of the expedition's food; it also recycled their waste water.

Jamie sat at the head of the table, with Trudy and Stacy on his left and Vijay at the other end, facing him. She smiled at him and he made a self-conscious smile back at her.

"Sleep well?" Trudy asked, her face the picture of innocent curiosity.

Jamie nodded and turned his attention to the bowl of instant cereal in front of him.

Conversation was a strain. No matter what Hall or Dezhurova said, it sounded to Jamie like arch references to sex. Vijay seemed perfectly relaxed, though. She's *enjoying* this banter, Jamie thought.

He went through his meal as quickly as he could and then headed for the comm center.

"I've got to check in with the others," he said to them.

"I already talked with both of the teams," Stacy called to his retreating back. "Possum has a cranky fuel cell, but otherwise everything is OK."

Jamie stopped and turned back toward her. "And Tomas?"

"They're heading off for the big caldera, on schedule."

"Good," said Jamie. Then he kept on walking toward the comm center.

A few minutes after he had spoken with Fuchida, Vijay slipped into the cubicle and sat beside him.

"It isn't a crime, you know," she said, a slight smile curving her lips.

"I know."

"Consenting adults and all that."

"I know," he repeated.

"Did you think the others'd be jealous?"

"Aw, come on, Vijay . . . "

She laughed lightly. "That's better. Lord, you were uptight back there!"

"Do they know?"

"I didn't say anything, but the way you were behaving they must have guessed it."

"Damn."

"It's nothing to be ashamed of."

"I know, but—"

"It happened, Jamie. Now forget about it. Get on with the program. I'm

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not trying to force a commitment out of you. I don't want that."

He felt relieved and disappointed at the same time. "Vijay, I . . . look, this kind of complicates everything."

She shook her head. "No worries, mate. No complications. It happened and it was very nice. Maybe it'll happen again, when the moon is right. Maybe not. Don't give it another thought."

"How the hell can I not give it another thought?"

Her smile returned. "That's what I wanted to hear from you, Jamie. That's all I wanted to hear."

"Hydrogen is the cussedest damned stuff in the universe," Craig was muttering as he drove the rover. That red warning light still glared from the control panel.

Sitting beside him, Dex said, "But the Lord must've loved hydrogen—"

"Because He made so much of it," Craig finished for him. "Yeah, I know."

"Ninety percent of the universe is hydrogen, Wiley. More."

"That's why the universe is so damned cantankerous."

"What've you got against hydrogen—beside the fact that it's leaked out of the fuel cells?"

"Stuff always leaks. It's sneaky-pete stuff, leaks through seals and gaskets that'd hold anything else."

"The seals on that fuel cell should've held the hydrogen," Trumball said, more seriously. "The manufacturer's going to pay a forfeiture fee because they didn't make the seals hydrogen-tight."

"Helluva lot of good that'll do us if we get ourselves killed out here."

"Hey, lighten up, Wiley! It's not that serious. We're OK."

"I don't like headin' away from the base with our backup power system dead."

"We can take on more hydrogen when we get to the fuel generator," Trumball said.

"Uh-uh. The generator produces methane and oxy. Not hydrogen."

"There's a water generator on board, isn't there?"

"Yeah."

"So," Trumball waved a hand in their air, "we take on extra water and electrolyze it into oxygen and hydrogen. *Voilà!*"

Craig cast him a sour look. "Electrolyze the water."

"Right."

"And what do we drink, amigo?"

"Water from the fuel cells."

"Now wait a minute . . . "

"Naw, you listen to me, Wiley. Here's the thing of it: We take on the water, electrolyze it and use the hydrogen to run the fuel cells."

"What about the oxygen?"

"Store it, dump it, whatever. We've got plenty oxy anyway. You with me so far?"

"We pump the hydrogen into the goddamned leaky fuel cells, big deal."

"Yeah, but we run the fuel cells to provide our electricity at night, instead of the lithium batteries."

"Now, why the hell—"

"So it doesn't matter if the fuel cells leak; we'll work 'em and get power out of 'em before the hydrogen leaks away."

Both hands on the rover's steering wheel, his eyes fixed on the land ahead, Craig looked like a man waiting for a card shark to deal him a deuce.

"Now what else do the fuel cells produce besides electricity?" Trumball asked, grinning with all his teeth.

"Water."

"Which we drink a little of and electrolyze the rest into fresh hydrogen and oxygen to run the fuel cells!"

Craig shook his head. "Great. You've invented the perpetual motion machine."

"Yeah, sure. I'm not that dufo, Wiley. We'll lose hydrogen all the time, I know that. But the loss'll be slow enough so we can use the fuel cells for overnight power all the way out to Ares Vallis and back to the generator!"

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"You done the math?"

"I did some rough numbers. I'll put it through the computer as soon as you give me an accurate fix for the fuel cells' normal efficiency rating."

Scratching his stubbly jaw, Craig said, "That data oughta be in the computer files."

"OK, go get it."

The older man hesitated. "We'll need approval. I'll have to tell Jamie what we're plannin' to do and he'll prob'ly buck it up to Tarawa."

Trumball grinned his widest. "Ask for all the approvals you want, Wiley, as long as we do it anyway."

"Now wait a minute—"

"What're they going to say?" Trumball interrupted. "If they say no, they're effectively cancelling the excursion. And we won't let them do that to us, will we?"

"You mean, even if they say no we go ahead anyway?"

"Sure! Why not? How're they going to stop us?"

"Use the fuel cells for overnight power?" Jamie asked, not certain he had heard Craig correctly.

"It's sorta like turnin' a lemon into lemonade," Possum replied.

Jamie stared at the display screen. Craig's unshaven face was dead serious. He appeared to be sitting in the cockpit, in his coveralls. Dex must be right beside him, driving. A glance at the data readouts on the displays beside the main screen showed that the rover was plowing ahead at a steady thirty kilometers per hour.

"It sounds risky to me," Jamie said, stalling for time to think.

"We been through the numbers," Craig replied. "It oughta work."

"And if it doesn't?"

"Then we'll be ridin' along without a backup power system, the way we are now."

"I don't like it."

"The alternative," Trumball's voice interjected, "is to scrub this excursion and come home with our tails between our legs."

"That's what your father wants," Jamie said. He had intended to wait until evening and speak to Dex privately about the elder Trumball's ire. Dex's father had sent three replies to Jamie's last message within the past twelve hours, each one more furious than the one preceding it.

A hand engulfed the view of the rover's cockpit and swivelled the camera to focus on Dex.

"Dear old dad's prone to displays of temper," he said easily, grinning. "Just relay his messages to me. I'll handle him."

"You just might be shooting down the funding for the next expedition, Dex," Jamie said.

Trumball shook his head vigorously. "No way. Once we bring back this Pathfinder hardware, investors will be running after us with money in their hands."

So that you can come back to Mars and loot it of anything else you can lay your hands on, Jamie thought. He pictured Trumball in a conquistador's steel cuirass and helmet.

A hand swivelled the camera again. "I ain't worried 'bout the next expedition," Craig said somberly. "I just want to get through with this excursion in one piece."

"I'll have to talk to Tarawa," Jamie said, hating himself for bucking the decision upstairs.

"OK, fine," came Trumball's voice. "It'll take us at least another week to reach the generator."

Damn! thought Jamie as he went through the motions of continuing their discussion. Dex knows damned well that the farther out they are, the less chance of calling them back.

Once he signed off and cut the connection to the rover, though, a different thought wormed into his consciousness: The longer they're out on their excur-

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sion, the longer Dex is away from here. Away from Vijay.

He hated himself even more for that.

"Y'know, we shoulda flown out to the Pathfinder site," Wiley Craig mused as he drove the rover through the dry, cold morning across the Plains of the Moon.

"Tired of driving?" Dex Trumball asked, sitting in the cockpit's right seat.

"Kinda boring right now."

"I checked out the idea," Dex said. "The rocketplane doesn't have the range to make it out to Ares Vallis."

"Coulda hopped the fuel generator and gassed 'er up, just like we're doin' for this wagon."

"I suppose so. But we'd need a couple of fillups and that would mean flying the generator at least two different hops. And landing the plane twice more, too."

"Too risky, huh?"

"Oh, I wouldn't mind the risk," Dex said quickly. "But the rocketplane couldn't carry the hardware once we got there. Not with a full fuel load, at least."

Craig let out a long sigh that was almost a moan. "So we drive."

"We're getting there, Wiley."

"Awful slow."

"We're setting a record for a land traverse of an alien world. We'll be covering close to ten thousand klicks before we're back at the base."

"More'n those guys who circumnavigated Mare Imbrium back on th' Moon?"

"Oh, hell yes. They only covered twenty-five hundred kilometers."

"Huh."

"Pikers."

"Small-time stuff."

Trumball grinned at his partner. They were both unshaven, their chins and cheeks bristly with the beginnings of beards they had agreed not to cut off until they returned to the domed base.

"We're driving across what used to be the bottom of an ancient sea," Trumball said, gesturing at the undulating ground outside. "I bet if we stopped to do some digging we'd find plenty of fossils."

Craig cocked a brow at him. "And how'd you recognize what's a fossil and what's just a plain ol' rock? Think you'll find trilobites or a chambered nautilus that looks just like fossils on Earth?"

Dex took a deep breath, almost a sigh. "No, I guess not. They'd be different."

After a few moments of silence, Dex said, "Let me ask you something, Wiley."

"What?"

"I've been trying to convince Jamie we should move our base camp to the Canyon, but he's too stubborn to even consider it. Whose side are you on? Mine or Jamie's?"

Jamie stared at the three-dimensional image of the cliff face, bending over the immersion table display and concentrating as if he could make the ancient village appear before his eyes by sheer willpower.

Stacy Dezhurova was at the comm console, as usual. Trudy and Vijay were tending the hydroponic garden. And Jamie was growing impatient.

I should never have let Dex go out on this crazy excursion of his, he told himself. Not only is it getting me in hot water with his father, it's screwing up the mission to the ancient village.

Jamie knew that he could not head out for the Canyon while four of the expedition's people were in the field. He had to wait for them to come back to the dome. Fuchida and Rodriguez would return from Olympus Mons in a few days, unless they ran into trouble. But Dex and Possum won't be back for another four weeks, at least.

Don't let yourself get so worked up about it, he said silently. Be patient. If it's really an ancient village tucked in those cliffs, it's been there a long, long time. Another few weeks isn't going to make much difference.

Still he burned to get going, to get out of this dome, out in the field, away from the others.

Away from Vijay, he realized.

She's got me wound up like a spring.

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First no and then yes and now maybe. Is she doing it on purpose? Trying to drive me crazy? Is it her sense of humor?

Strangely, he found himself grinning at the thought. We're already crazy. We wouldn't be here otherwise. This just adds another dimension to the craziness.

Be calm, the Navaho side of his mind advised. Seek the balanced path. Only when you're in balance can you find beauty.

Sex. We tie ourselves into knots over it. Why? She can't get pregnant. Not here. Not unless she really wants to and she's too smart to want that. So what difference does a little roll in the hay make?

Then he thought of her admission that she had slept with Trumball, and Jamie knew that sex could be a fuse that kindles an explosion.

Take it one step at a time, he thought. One day at a time. Then he grinned again. One night at a time.

Dezhurova's voice cut into his awareness. "Jamie, you should take a look at this."

Jamie straightened up, felt his vertebrae pop, and turned toward the comm console, where Stacy was sitting with a headset clipped over her limp sandy-blonde pageboy.

"What is it?"

"Latest met forecast from Tarawa."

Jamie saw a polar projection map of Mars' two hemispheres, side by side, on Dezhurova's main screen. Meteorological isobars and symbols for highs and lows were sprinkled across it.

Stacy tapped a fingernail on a red L deep in the southern hemisphere. Jamie noticed that her nails were manicured and lacquered a dark red.

"That is a dust storm," she said.

Bending over her shoulder to peer at the map, Jamie nodded. And noticed that Stacy was wearing a flowery perfume.

"Way down on the other side of Hellas," he muttered.

"But they're forecasting it to grow." She touched a key and the next day's map appeared on the screen. The storm was bigger, and moving westward.

"Still way below the equator," Jamie said.

"Even so."

"Can you get a real-time view of the area?"

"On two," she replied. The screen immediately to her right brightened to show a satellite view of the region.

"Dust storm, all right," Jamie said. "Big one."

"And growing."

He thought aloud, "Even if it grows to global size it'll take more than a week to bother us here. Fuchida and Rodriguez will be back well before then."

"But Dex and Possum . . . "

Jamie pictured Dex's reaction to being called back to base because of the possibility of a dust storm engulfing him. I'd have to order him to return, Jamie knew. And he might just ignore the order.

"Tell Tarawa I need to talk to the meteorology people right away," he said to Stacy.

"Right."

Dex Trumball frowned as he listened to Jamie on the rover's comm link.

"The meteorology people don't expect the storm to get across the equator, but they're keeping an eye on it."

"So what's the problem?" Trumball asked, glancing over at Craig, driving the rover.

The ground they were traversing was rising slightly, and rougher than the earlier going. A range of rugged hills rose on their left, and the last rays of the dying sun threw enormously elongated shadows across their path, turning even the smallest rocks into dark phantoms reaching out to block their way.

"It's a question of timing," Jamie replied. "Each day you get farther from the base. If we wait to recall you until the storm's a real threat, it might be too late."

"But you don't know that the storm's

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going to be a real threat, do you?"

"The prudent thing to do," Jamie said, "is to turn back and try this excursion again late in the summer, when the threat of storms is practically zero."

"I don't want to turn back because of some ding-dong threat that probably won't materialize."

"It's better than getting caught in a dust storm, Dex."

Trumball looked across at Craig again. The older man gave him a sidelong glance, then returned to staring straight ahead.

"You made it through a dust storm, didn't you?" he said. "On the first expedition."

It took several moments for Jamie to reply, "We had no choice. You do."

"Well, lemme tell you something, Jamie. I choose to keep on going. I'm not going to stop and turn back because of some cockamamie storm that's a couple thousand klicks away."

Sitting in front of the comm console, with Stacy beside him and Vijay at his back, Jamie kneaded his fists into his thighs.

If I order him to return and he refuses, then whatever authority I have over these people goes down the drain. But if I let him continue then they'll all know that Dex can do whatever he wants to and I have no way to control him.

He realized that it was Dex who was making the decisions. The idea of putting Craig in charge was a farce from the beginning. Possum was not raising his voice, not saying a word at all.

Which way? Which path? Jamie thought furiously for several silent moments. He drew up in his mind an image of Trumball's route across Lunae Planum and into Xanthe Terra.

"Hold on for a minute, Dex," he said, and cut off the transmission.

Turning to Dezhurova, he ordered, "Let me see their itinerary, Stacy."

She punched up the image on the screen before Jamie's chair. A black line snaked across the map, with pips marking the position expected at the end of each day. Jamie scanned it swiftly, then hit the transmit key again.

"Dex?"

"We're still here, chief."

"If the storm crosses the equator and threatens you, it won't happen for at least four or five more days. By then you'll be much closer to the fuel generator than to the base, here."

"Yeah?" Trumball's voice sounded wary.

"In two days from now you ought to be at the halfway point between here and the generator."

"Right."

"That's going to be our decision point. The point of no return. I'll decide then whether you can keep going or have to turn back."

"In two days."

"Yes. In the meantime we'll keep close track of the storm. Stay in touch with us hourly."

This time it was Trumball who hesitated for several moments before answering, "OK. Sure."

"Good," said Jamie.

"We'll be bedding down for the night in another hour," Trumball said. "Call you then."

"Good," Jamie repeated.

He cut the transmission and leaned back in the little wheeled chair, feeling as if he had sparred ten rounds with a professional boxer.

Dex Trumball was driving slowly through the inky blackness of the Martian night.

"Supper's on the table," Craig called out. "Come on and eat it or I'll throw it to th' hawgs."

"Why don't we keep on going, Wiley?" Trumball asked over his shoulder.

"'Cause we don't want to break our cotton-pickin' necks, that's why. Shut 'er down for the night, Dex."

"Aw, come on, Wiley. Just a few klicks more."

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"Now," Craig said, with iron in his tone.

With a sigh, Trumball leaned on the brake pedals and brought the rover to a slow, smooth stop.

Once he had shut down the drive motors and come back to the table between the bunks, Dex sank down on the edge of his bunk and stared for a few moments at the tray of prepackaged dinner.

"I know what you're up to, y'know," Craig said, sitting on the edge of his own bunk, on the other side of the folding table.

Dex grinned at the older man. "Yeah? What?"

"You wanta get so close to the generator that when Jamie comes to his decision point we'll be closer to it than to th' base. Right?"

With a nod, Trumball answered, "Why not?"

"You're not scared of a dust storm?"

"Wiley, if Jamie weathered one of those storms during the first expedition, why can't we?"

"Be smarter to be back at the base when a storm hits, nice 'n' cozy."

"*If* a storm hits. How'd you feel if we turned tail and went back to the dome and then no storm materializes?"

"Alive," said Craig.

Trumball considered the older man for a moment. Then, as he dug a plastic fork into the unidentifiable stuff on the tray before him, he asked, "If Jamie orders us back, what'll you do?"

Craig stared back at him, sad, pouchy ice-blue eyes unwavering. "Don't know yet," he answered. "But I'm turnin' over the possibilities in my mind."

Trumball grinned at him. "Yeah? Well, turn this over, too, Wiley. There'll be a finder's fee for picking up the Pathfinder hardware. A nice sizable wad of cash for the guys who bring it back. That'll be you and me, Wiley."

"How much?"

Trumball shrugged. "Six figures, I guess."

"H'mp."

Watching the older man's face carefully, Trumball added, "Of course, I don't need the money. I'd be willing to give my half to you, Wiley. If we keep on going no matter what Jamie says."

Craig's face was impassive. But he said, "Now that sounds purty interesting, ol' pal. Purty damn' interesting."

"How's the weather report?" Craig asked.

"About the same," Dex replied, from up in the rover's cockpit. He was driving while Craig cleaned up their breakfast crumbs and folded the table back down into the floor between the bunks.

Craig came up and sat in the right-hand seat. The sun was just clear of the increasingly rugged eastern horizon.

"Want me to drive?" he asked.

"No way, Wiley. I'm going to break the interplanetary speed record today and get this baby up to thirty-five klicks per hour."

Craig made a snorting laugh. "You'll need a helluva tail wind for that, buddy."

"Nope, just some downhill slope."

"Lotsa luck."

"I'm not kidding, Wiley. The plain slopes downhill all the way to Xanthe."

"Sure," said Craig. "And if we had a good breeze behind us we could really make time."

Trumball glanced at him, then said, "Check the incoming messages, huh?"

There were two messages in the file, both from Trudy Hall. The first one told them about Fuchida's accident in the caldera atop Olympus Mons and Rodriguez's rescue of him. And the biologist's discovery of the siderophiles. The two men listened to Hall's brief summary, then glanced at each other.

Craig let out a low whistle. "I wonder what Mitsuo's Jockey shorts look like."

Trumball laughed and shook his head. "I don't want to know."

Hall's second message was a weather report. The dust storm was spreading, but still confined below the equator.

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"Long as it stays in the southern hemisphere we're free and clear," Trumball said happily.

Craig was less cheerful. As he stared at the weather map on their screen he muttered, "It's growin', though. If it crosses the equator we're gonna be in trouble."

"Don't be a dweeb, Wiley. This vehicle's been through a dust storm before, y'know."

"Yeah, and I've jumped off a burning oil platform into th' Gulf of Mexico, too. Doesn't mean I wanna do it again."

Trumball's answer was to lean harder on the accelerator. Craig watched the speedometer edge up past thirty-one kilometers per hour. With a grim smile, he remembered an old prizefighter's maxim: You can run but you can't hide.

"By golly, there she is!"

Wiley Craig pointed with his right hand while keeping his left on the steering wheel.

Dex Trumball squinted into the bright morning sun. Off on the rough, crimson horizon he saw a tall metal shape, gleaming and alien-looking in the Martian landscape.

The rover was plunging at top speed across a field of rocks, its spindly, springy wheels jouncing and rattling them so hard they had both strapped themselves into the cockpit seats.

"We've drifted too far north, Wiley," said Trumball. "It's going to cost us a half a day to get to her."

Craig's bristly, bearded face was split by a big, gap-toothed grin. "Don't care how far away she is; she shore looks purty, don't she?"

Dex nodded and admitted, "Yeah, she sure does."

The dust storm in the southern hemisphere had petered out at last, according to the previous night's weather report. Craig had expressed great relief. Trumball, equally grateful that the storm would not hit them, played it much cooler.

"Even if it had crossed the equator, we could've ridden it out."

"I don't know, Dex," Craig had said soberly. "Some of those storms last for weeks."

"Not this time of year."

"Uh-huh. And it never rains in California."

Trumball got up and headed back toward the equipment racks near the airlock while Craig steered the rover through the rock field and onto smoother, slightly higher ground. The generator took shape before his eyes, a tall polished aluminum cylinder catching the glint of the morning sun, resting on three slim-looking metal legs, the nozzles of three rocket engines hanging beneath the vehicle's end skirt.

"Come on," Dex called from the rear of the rover module, "goose her up a little more. Let's make as much time as we can."

"Let's not throw a wheel, either," Craig countered. "Another half-hour ain't gonna kill us."

Trumball grumbled to himself as he checked out the video monitoring equipment. The outside cameras were recording everything; not only would the views be a bonanza for geologists studying Mars, they would be great background material for the virtual reality tours that Dex would beam Earthward.

By the time Craig pulled the rover to a stop next to the generator Dex was suited up and already stepping into the airlock.

"You just wait a minute there, buddy," Craig called to him. "You're not goin' outside without being checked out."

"Aw, come on, Wiley. I went through the checklist myself. Don't chickenshit me."

But Craig would not be put off. He checked Trumball's suit quickly but thoroughly, then pronounced him ready to go outside.

"I'll holler when I'm suited up and you come back in and check me over."

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"Yeah, yeah."

The generator was chugging away, sucking up water from the line it had drilled down to the permafrost level under Craig's remote guidance, pulling in the thin Martian air and separating its components automatically.

By the time Craig came through the airlock hatch and stepped onto the rusty ground, Trumball had ascertained that the methane and water tanks were both filled almost to capacity.

"OK, great," Wiley said. "Now we gotta fill our tanks."

It took more than an hour. While Craig handled the hoses and watched the gauges, Dex beamed a VR session back to Tarawa: the intrepid explorers hacking their way through the Martian wilderness have made their rendezvous with the refueling generator. On to Pathfinder!

Once they climbed back inside the rover, Dex scrambled quickly out of his suit and made his way to the cockpit. A brief scan of the control panel showed everything in the green, except for the glowering red light of the fuel cells. We'll get that into the green, too, he told himself. Soon as Wiley electrolyses enough of our water to feed 'em.

By sundown they were well on their way toward Ares Vallis, the generator below their horizon and out of sight. Dex was still driving, Craig in back tinkering with the fuel cells.

"How're they holding?" Trumball called over his shoulder.

Craig's weary sigh was audible even from the rear of the module. "Leakproof welds my hairy butt," he groused.

"What's the matter?"

"These damn dewars are supposed to hold liquid hydrogen," Craig said, kicking a booted toe on the stainless steel cylinder on the rover floor.

"Yeah?"

"Well, the damned welds on 'em leak like a sieve that's been shotgunned."

"They're still leaking?"

"Does the Pope eat spaghetti?"

"How bad?"

Craig clumped up toward the cockpit and slid into the right-hand seat. "I gotta do some calculations. It ain't good, though, I can tell you that without a computer."

Trumball saw that Craig was more disgruntled than worried. We can get along without the fuel cells, he thought. Hell, we've been getting along without 'em for days now. Still, it'd be good to get that damned red light off the board.

"The newest fuel cells back on Earth use nanotube filaments to store the hydrogen," Craig was muttering. "Nanotubes *work*, pardner. They soak up molecular hydrogen like a sponge and hold onto it like a vise. But all we got is these leaky damned dewars."

The sun was nearing the horizon, Dex saw. A thin patch of cloud high above was already reflecting brilliant red highlights.

"We're going to have a beautiful sunset, Wiley."

Craig looked up from the panel's computer display. "Yep. A purty one. Reminds me of Houston. We used to get some bee-yootiful sunsets there, thanks to all the industrial waste the refineries poured into the air."

Trumball laughed. "No factories out here."

"No, but . . . " Craig's voice petered off into thoughtful silence.

"What's the matter, Wiley?"

"Those clouds."

At that instant the communications chime sounded. Trumball tapped the ON button and Stacy Dezhurova's face appeared on the panel screen.

"Latest weather report," she said, looking worried. "New dust storm has started, this time in the northern hemisphere."

"Where?" Trumball asked.

"Exactly where you're heading," came her reply.

Jamie stared at the weather map on the screen. He had superimposed the position of Trumball and Craig's rover,

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and the route they had to follow to reach the Pathfinder.

The storm's going to roll right over them, he saw.

"What do you want to do?" Stacy Dezhurova asked from her chair at the comm console.

Jamie looked up at her. She looked concerned.

"They're more than halfway to the Pathfinder site," he said, thinking aloud. "If I tell them to turn around and head back to the generator the storm will overtake them anyway."

"So you think they should just keep on going?"

"The storm's heading east to west; they're going west to east. They could drive through it."

"Assuming they can drive when the storm hits them."

"If not, they'll have to sit still until it passes them."

Dezhurova nodded, her normally somber face positively morose.

"If only we could predict how big the storm's going to get," Jamie muttered. "We've been studying Martian weather for more than twenty years now and we still can't make a decent forecast."

Stacy made a weak grin. "They have been studying terrestrial weather for almost two centuries and the meteorologists still can't make a decent forecast on Earth, Jamie."

"It might not be as bad as it looks," he said, remembering the storm he had endured. "If they button up tight they'll be all right."

"But what if the storm grows? The big ones take weeks to clear up . . . months."

With a grimace, Jamie said, "This one doesn't look that bad. So far."

Dezhurova countered, "The one in the southern hemisphere hung in for a solid week."

"I know," he admitted, staring again at the weather map, as if he could force it to reveal its secrets if he scowled at it hard enough.

Dezhurova fell silent, letting Jamie work out his thoughts for himself. At last he got to his feet and said, "We'll thrash it out over dinner. Let everybody chip in their ideas."

With Fuchida and Rodriguez back from Olympus Mons, there were six of them at dinner. Even so, their ideas were almost nonexistent. They talked the situation over through dinner, mulling through one possibility after another. It all boiled down to a choice between letting Craig and Trumball continue into the storm or ordering them to turn back to the generator and allowing the storm to catch up with them.

"They're way too far out to get back here before the storm overtakes them," said Rodriguez. "They're gonna get caught in it, one way or the other."

"Dex won't want to turn around," Vijay said, with firm certainty. "He'll want to push ahead, no matter what."

"If only we knew how big the storm will grow," Trudy Hall said. "We're trying to make a decision rather in the blind, don't you think?"

"The storm will grow," Fuchida predicted. "It might even reach us here."

"Here?" Trudy looked suddenly alarmed.

"It's a strong possibility," said Fuchida. He was sitting with his bad leg propped on an empty chair. Vijay had x-rayed his ankle, injured on Mt. Olympus, and found no fracture. She had wrapped it tightly with an elastic bandage.

"Are you a meteorologist, too?" Stacy asked the Japanese biologist, straight-faced.

"Yes, I am," Fuchida replied with dignity. Then he added, "When I call up the meteorology program on my laptop."

Rodriguez pointed out, "The biggest problem is the solar cells. If the dust covers them, the rover loses its primary power source."

"So they go to the batteries," Hall said.

"For how long? Their fuel cells aren't working right, remember. Their backup power system isn't reliable."

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Trudy looked surprised. "I had forgotten that."

"They can't sit in the dark for more than forty-eight hours—fifty, tops," Rodriguez said.

"They can stretch it if they power down," said Jamie.

"How far? They got to keep the heaters going, and that's what takes up most of the juice."

Stacy Dezhurova said, "If they go back to the generator that can refill the fuel cells as much as they need to."

"That's right," Jamie said, pushing himself up from the table. "But my instinct is to let them continue ahead; it's the shortest path out of the storm."

"Unless the storm grows much larger and stronger," Hall said.

"If it grows that much they're in trouble no matter what they do."

"And the dust might damage the solar cells," Rodriguez added gloomily. "Degrade them to the point where they can't provide enough power to run the rover."

"That's a cheerful thought," Hall said.

The others nodded glum agreement.

Jamie went to the comm center again and sat at the main console. All the others crowded in behind him. As he called to the rover, Jamie felt the heat and tension in the little cubicle. Too many bodies pressed together. Too many fears building up.

Mars is a gentle world, he reminded himself as he waited for the rover to reply. It doesn't want to harm us.

No, the other side of his mind replied. Not unless you do something stupid, like get caught in a dust storm three thousand klicks from home.

Craig's scruffy face filled the screen. From what Jamie could see, he was still driving the rover through the lengthening shadows of nightfall.

Jamie went through the situation and the two possible courses of action with Craig. Then he asked, "Possum, what do you think? Which way do you want to go?"

Before Craig could answer, Dex Trumball pivoted the camera to himself and said, "We're pushing on! No sense turning tail."

Patiently, Jamie said, "Dex, I asked Possum, not you. He's in charge."

"Wiley and I agree," Trumball insisted. "We want to keep on going and get the hell out of this storm. Turning back would be a waste of time."

"It might be the safer course to take," Jamie said. "You could make it back to the generator before the storm overtook you, and ride it out there, where you're assured of fuel, water and oxygen."

"We're going forward," Trumball snapped.

"Possum, what do you have to say about it?" Jamie asked.

The camera view swivelled back to Craig's jowly face. "First off, I'd rather be called Wiley than Possum. Second, I agree with Dex: let's push ahead and get through this blow."

Jamie sat digesting that for a few silent moments. He could feel the others stirring nervously behind him.

"You're sure?" he said, stalling for time to think.

"Yep," Craig replied.

It would be safer for them to camp by the generator, Jamie told himself. But if the storm lasts for a week or more they'll run out of food and have to start back. Without getting the Pathfinder hardware. Their whole trek would be for nothing. That's what's eating at Dex. To go all the way out there and return empty-handed. That's what's fueling his fire.

On the other hand, he thought, what if they get killed out there? Is the hardware so important that I should let them risk their lives over it?

Trumball swung the camera back to his own face. His ragged dark beard made him look truculent, belligerent, as if he were daring Jamie to contradict him.

"Well?" he demanded. "What are your orders, chief?" The sarcastic stress he laid on the word *orders* was obvious.

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"Keep on going," Jamie heard himself say. "And good luck."

Trumball looked surprised.

Vijay followed Jamie into his cubicle when they all filed out of the comm center. What the hell, Jamie thought. If the others didn't realize we've been sleeping together, they know it now.

Later, cupped against one another in the narrow bunk, she whispered to him, "You did the right thing, Jamie."

"Did I?"

"Dex wouldn't have obeyed an order to turn around. He would have defied you openly."

Jamie sighed in the darkness. "Yes, I suppose he would have."

"It was smart to avoid an open conflict."

"Maybe."

"You don't think so?"

"It's not important," he said.

"But it is!" She propped herself on one elbow and looked down at him. "Your authority shouldn't be challenged."

"That doesn't worry me, Vijay."

"It doesn't? Then what does?"

He gazed up at her lovely face, outlined in the faint glow from the digital clock. So beautiful, so serious, so concerned about him.

"What bothers me is that I *want* Dex to be away from here. Away from you. Away from us."

"Wind's pickin' up," Wiley Craig said.

Trumball was driving the rover with single-minded concentration through a field of rocks big enough to stop army tanks, steering between the minivan-sized boulders while his geologist's mind begged to go outside and see what they were made of. No time for that, Dex told himself, glancing up at the darkening sky. We'll do the science on the way back.

Craig was peering at the readouts on the display screen. The wind was up to eighty-five knots: hurricane speed on Earth yet only a zephyr in the rarified atmosphere of Mars. But the wind speed was increasing, and off on the horizon before them an ominous dark cloud hung low over the land.

"How're the fuel cells doing?" Trumball asked, without taking his eyes from his steering.

Craig tapped a few keys on the control panel. "Down to sixty-three percent."

"Might as well use them as soon as the solar cells crap out," Trumball said, through gritted teeth. "Save the batteries."

"Use 'em or lose 'em," Craig agreed. "Get some work outta them before they fade to zero."

It took a conscious effort for Dex to unlock his jaws. He had clamped his teeth together so hard it was giving him a headache. If it wasn't so scary it'd be funny, he told himself. I'm steering this buggy like a kid in a video game, trying to get through this frigging rock field and out into the open before the storm hits us.

"Any new data on the storm?" he asked.

Craig tapped more keys, stared at the display screen a moment, then sighed mightily. "She's gettin' bigger."

"Great."

We should have gone back to the generator, Dex admitted silently. Jamie should've *ordered* us to go back. Wiley should've insisted on it. This isn't a game; that storm could kill us, for chrissakes.

"Want me to drive?" Craig asked gently.

Trumball glanced at the older man. "Wiley, if I wasn't driving I'd be biting my fingernails up to the elbows."

Craig laughed. "Hell, this isn't all that bad, Dex. Lemme tell you about the time a hurricane hit us while we were tryin' to cap a big leak on an oil platform in the Gulf of Mexico. Right near Biloxi it was . . . "

Trumball listened with only half his attention, but he was grateful that Craig was trying to ease his tension. It wasn't

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working, of course, but he was grateful that Wiley was at least trying.

"It's definitely going to reach your base camp," said the meteorologist. "At its present rate of growth and forward speed, the storm will overrun your area in two days—er, that's two Martian days, sols."

Jamie and Stacy Dezhurova watched the report in the comm center. The meteorologist appeared to be in Florida, perhaps Miami. Jamie could see palm trees and high-rise condos through the man's office window, behind his youthful but intently serious face.

The young meteorologist went on to give all the data he could present: maximum wind speeds would be above two hundred knots; the storm's forward progress was a steady thirty-five knots; height of the clouds; dust burden; opacity. Many of the numbers were estimates or averages.

"We must make certain all the planes are tied down really tight," Stacy muttered as the meteorologist droned on.

Jamie nodded. "And the generator, too." He knew, in the calculating side of his brain, that even a two-hundred-knot wind on Mars did not have the force to knock down the tall cylinder that housed the fuel and water generator, especially when its tanks were full. The Martian atmosphere was so thin that there was little punch to its winds. Yet the other side of his mind pictured the generator toppling, blown over like a big tree in a hurricane.

Dezhurova nodded. "We must get on it right away."

"Tomas and I will do the outside work," Jamie said once the meteorologist finished his report. "You see that everything in here is buttoned up and everybody's ready for a blow."

He slid his wheeled chair to the screen where the meteorologist's frozen image stared out at them, face lined with concern, and punched the transmit key.

"Dr. Kaderly, thanks for your report. It helps a lot. Please keep us updated and let us know immediately if there's any change in the storm's progress."

Then he turned back to Stacy, sitting beside him. "Send Kaderly's report to Poss . . . I mean, to Wiley Craig and Dex. Then get the others started getting ready for the storm."

"Right, chief."

Jamie got up and headed for the airlock and the hard suits waiting by the lockers there. Somehow he didn't mind it when Stacy called him chief. There was no mockery in her tone.

As he began pulling on the rust-stained leggings of his hard suit, Jamie thought about Dex and Craig out there between Xanthe and Ares Vallis. They're going to be caught in the storm for two sols, at least. Without a backup electrical system. The batteries ought to see them through OK, if they power down to a minimum. That means they're going to have to stop and sit there until the storm blows past them.

They'll be OK. If they just keep their cool and wait it out, they'll get through the storm all right.

If the dust doesn't damage their solar panels.

"What do you think, Wiley?" asked Dex Trumball as soon as the meteorologist's detailed report ended.

Craig was driving the rover at a steady thirty klicks per hour. "How the hell fast is one knot? I always get confused."

Sitting in the right seat, staring out at the darkening horizon in front of them, Dex said, "It's one nautical mile per hour."

"What's that in real miles?"

"Does it make that much difference?"

Craig hunched his shoulders. "Naw, I guess not."

"It's about one point fifteen statute miles."

"Fifteen percent longer'n a regular mile?"

"That's right." Trumball was starting

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to feel exasperated. What difference did fifteen percent make? They were driving straight into a dust storm. A big one.

"So it'll take about two sols for the storm to pass over us."

"If we're sitting still, yes."

Craig glanced over at Dex, then turned back to his driving. "You want to keep mushing ahead?"

"Why not? As long as the solar cells are working, why not push ahead? Get the hell out of this mess as quick as we can."

"H'm." Craig seemed to think it over carefully. "Hell of it is, we got some nice smooth territory here. Pretty easy driving."

The land outside was not entirely free of rocks, but it was much more open and flat than the broken and boulder-strewn region of Xanthe they had been through. The ground was sloping downward gently, generally trending toward the lowlands of the Ares Vallis region.

"We're going to turn this route into a regular excursion for the tourists, Wiley," Dex said, mainly to take his mind off the ominous cloud spreading across the horizon before them.

"Build a road? Out here?"

"Won't need a road. We'll put up a cable-car system, like they're doing on the Moon. Just put up poles every hundred meters or so and string a line between 'em. The cars hang from the line and zip along, whoosh!" Dex made a swooping motion with one hand.

Craig fell into the game. "The cable carries the electrical current to run the cars, huh?"

"Right," Dex said, trying not to look out at the horizon. "Cars can carry a couple dozen people. They're sealed like spacecraft, carry their own air, heat, just like this rover."

"Only they skim over th' ground," Craig said.

"They'll be able to go a lot faster that way. A hundred klicks an hour, maybe."

Without taking his eyes from his driving, Craig said softly, "Wish we had one of 'em now."

Dex stared out the windshield. It was starting to get dark out there. The mammoth cloud of dust was coming toward them like a vast Mongol horde of conquerors. Soon it would engulf them entirely and they would be lost in the dark.

He remembered an old adage about the weather:

Red sky at night, sailor's delight.

Yeah, but that was back on Earth. Here on Mars the sky was always red. And there hadn't been any sailors here for hundreds of millions of years, at least.

As he stared at the approaching cloud he shivered involuntarily.

Jamie was outside with Rodriguez, adding extra tie-down lines to the planes, when the call came through from Pete Connors, mission controller at Tarawa.

Inside his hard suit, he could not see the former astronaut, only hear his caramel-rich baritone voice. Connors sounded concerned, worried.

"Old man Trumball's on the warpath, Jamie. I just heard about it from Dr. Li. He called Li and raised hell about you. He's calling everybody on the ICU board. God knows who else he's bitching to."

Jamie had asked that Connors' call be put on the personal frequency, so that he could listen to the man in privacy.

"I don't need this," he muttered as he tugged at the line that held the soarplane's wingtip to one of the bolts they had sunk into the ground.

Connors' voice went on, unhearing, more than a hundred million kilometers away. "I've talked to several of the board members myself. None of them really wants to remove you, but they're pretty scared of Trumball. He must be threatening to cut off funding for the next expedition."

Straightening in the hard suit was not an easy task. Jamie found himself puffing

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with exertion as he looked back toward the dome. Fuchida and Dezhurova were in the garden bubble, carefully checking its plastic skin for pinhole leaks or wrinkles where the wind might grab and tear the fabric apart.

Once the dust starts blowing, will the particles have enough force in them to penetrate the bubble's skin? he wondered. Not likely, but then the odds against the main dome being hit by meteoroids were a zillion to one, and that had happened on the first expedition.

Connors was still talking. "I had a long talk with Fr. DiNardo about it. He's a damned good politician, that Jesuit, you know that? He says you should sit tight and ignore the whole thing. It'll probably blow over as soon as the storm dissipates and Trumball realizes nothing's happened to his son."

Jamie nodded inside his helmet as he walked over to the soarplane's other wingtip and started tightening the lines already fastened there.

"DiNardo said," Connors continued, "that you shouldn't even think about resigning unless Trumball keeps up the pressure even after the storm blows out and it becomes clear that a majority of the board's going to go along with him."

Resigning? Jamie thought, alarmed. He thinks I should resign?

Connors went on with his dolorous report, reminding Jamie several times more that he hated to bother him with this political maneuvering but he thought Jamie ought to know about it.

Finally he said, "Well, that's the whole story, up to now. I'll wait for your answer. Be sure you mark it personal to me; that way nobody else'll look at it. At least, nobody else *should* look at it. I don't know how many people around here are reporting to Trumball on the sly."

Wonderful news, Jamie groaned silently.

"Well, OK, that's it, pal. I'll wait for your answer. 'Bye for now."

Off on the eastern horizon, Jamie saw, the sky was darkening. Or is it just my imagination? he asked himself. I'll check the instrumentation when I get back into the dome.

How's that old rhyme go? Jamie asked himself. *Red sky at night, sailor's delight. Red sky at morning, sailor take warning.* What about when the sky turns black?

The storm's going to hit here, all right. No way around that. And now I've got another storm, a political squall, back on Earth.

He glanced down at the suit radio's keypad on his wrist, then said carefully, "Personal message to Pete Connors at Tarawa. Pete, I got your message. We're battening down for the storm right now, so I don't have time to reply. I want to think about this before I answer you, anyway. Thanks for the news, I guess. I'll get back to you."

Damn, he thought as he stared out at the eastern horizon. It sure looks like it's clouding up out there. Maybe the storm's picked up speed. That'd be good; it'll roll over Dex and Craig and get them out into the clear sooner.

Starting back toward the dome's airlock, Jamie said to himself, Why is Trumball so clanked up? Why is he out to remove me as mission director? Prejudice? Just plain malice? Or is he the type that's not happy unless he's forcing other people to jump through his hoops?

Then Jamie heard his grandfather whisper, Put yourself in his shoes. Find what's bothering him.

OK, grandfather, he replied silently. What's bothering the old man?

His son is in danger, came the immediate reply. He's worried about Dex's safety. That's natural. That's good.

But Trumball knew that exploring Mars carried its risks. Maybe he never considered that his own son would have to face those risks, just like the rest of us.

He was all in favor of going after the Pathfinder hardware. But he didn't think his son would be in any danger. Now he

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knows different and he's scared. He's sitting in an office in Boston and his son is out in the middle of a dust storm a hundred million kilometers away and there's nothing he can do about it.

Except get angry and vent his fury on the most convenient target he can find: the mission director who allowed his son to go out into danger. Me. He's pissed at me because he can't do anything else about the situation. He's scared and frustrated and trying to solve his problem the way he's solved problems before: fire the guy he's mad at.

Jamie took a deep breath and felt a calm warmth flow through him. He heard his grandfather's gentle laughter. "Never lose your temper with a customer," his grandfather had told him years ago, when Jamie had been a little boy angered by the pushy, demanding loud-mouthed tourists who yelled at Al in his Santa Fe shop. "Let 'em whoop and holler, it don't matter. Once they calm down they're so ashamed of themselves that they'll buy twice what they started out to buy, just to show they're sorry."

Damn! Jamie said to himself as he trudged back to the airlock. It would be so satisfying to get sore at Trumball, to send him a blistering message telling him to mind his own damned business. So easy to taunt the old man from a hundred million kilometers' distance.

But I can't get angry at him, Jamie realized. I understand what he's going through. I understand him and you can't hate a man you understand.

As he stepped into the airlock and swung its outer hatch shut, he reminded himself, But just because you understand him doesn't mean he can't hurt you. You understand a rattlesnake, too, but you don't let him bite you. Not if you can avoid it.

"That's all she wrote," said Craig.

He touched the brakes and brought the rover to a gentle stop.

"It's not even six o'clock yet, Wiley," Dex protested. "We can get in another hour or more."

Craig got up from the driver's seat. "I got an idea."

The sky was a dismal gray above them, getting darker by the minute. Dex could hear the wind now, a thin screeching sound like the wail of a distant banshee.

"I'll drive," he offered.

"Nope," said Craig, heading back toward the bunks. "You gotta know when to hold 'em and know when to fold 'em. We sit still now and get ready for the storm."

"It's not that bad yet," Trumball insisted, turning in his seat to watch the older man. "We can push on a little more, at least."

Craig knelt down and pulled open the storage drawer beneath the bottom bunk. "The real danger from the storm's gonna be the damage the sand does to our solar panels, right?"

"Right," Dex answered, wondering what his partner was up to.

Craig pulled a set of sheets from the storage drawer. "So we cover the solar panels."

"Cover them? With bedsheets?"

"And anything else we got," Craig said. "Coveralls, plastic wrap, anything we got."

"But once they're covered they'll stop producing electricity for us. We'll have to go onto the batteries."

Craig was emptying the drawer beneath the other bunk now. "Take a look at the instruments, buddy. It's gettin' mighty dark mighty quick. Those solar cells are already down to less'n thirty percent nominal, right?"

Dex glanced at the panel instruments. The solar panels' output hovered just above twenty-five percent of their maximum output.

"Right," he replied dismally.

"So don't just sit there," Craig called, almost jovially. "Get up and find the duct tape, for cryin' out loud."

Dex thought, This is just busywork.

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We won't be able to keep the panels covered once the storm hits. Wind speeds are going to over two hundred knots, for chrissake. That'll rip off anything we try to cover the panels with.

But he pushed himself out of the chair, wormed his way past Craig, and started searching through the supplies locker, grateful for the chance to be doing something active instead of just sitting and watching the storm approach them.

Wiley Craig ran the beam from his hand lamp across the rover from nose to tail.

"Well . . . it ain't a thing of beauty," he said, "but it oughta get the job done."

Standing beside him, Dex thought that the rover's top looked like a Christmas present wrapped by clumsy children. Bedsheets, plastic wrapping, a tarpaulin, and several sets of spare coveralls—sliced apart to cover more area—were spread over the solar panels and taped down heavily.

"Do you think they'll stay put once the wind starts up?" he asked.

Craig was silent for a moment, then said, "Oughta. Wind must be purty near seventy knots already and they're not flappin'."

Dex could hear the wind keening outside his helmet, softly but steadily, becoming insistent. He thought he also heard something grating across his suit's outer skin, like fine grains of sand peppering him. He almost could feel the dust scratching against him.

It was fully dark now. Dex felt tired, physically weary, yet his insides were jumpy, jittery. In the light from Wiley's lamp he could see that the air was clear; no dust swirling. None that he could see. Yet there was that gritty rasping on the suit's hard shell.

"We could have driven another hour," he said to Craig.

"Maybe."

"Hell, Wiley, I've driven through snowstorms in New England." Despite his words, Dex's voice sounded quavery, even to himself.

"This ain't the Massachusetts Turnpike out here, buddy."

"So what do we do now? Just sit and bite our nails?"

"Nope. We're gonna collect all the data we can. Then we're gonna have dinner. Then we're gonna get a good night's sleep."

Dex stared at Craig's spacesuited figure. He doesn't sound worried at all. The goddamned fuel cells are leaking and the solar panels are shut down and we'll have to live off the batteries for god knows how long and he's as calm and unruffled as a guy riding out a blizzard in a first-class ski lodge.

"OK, boss," Dex asked, trying to sound nonchalant, "what do you want me to do now?"

"You go inside and check the fuel cells, make sure all the comm systems are workin' and call back to the base, let 'em know we're buttoned up for the night."

Dex nodded. The commsats in orbit will pinpoint our location. If anything happens to us, he thought, at least they'll know where to find the bodies.

Craig whistled tunelessly as he trudged back to the airlock for a met/geo beacon to plant outside the rover. Dex went back inside and started to take off his hard suit. He knew that he should stay suited up and be prepared to go outside in case Craig got into trouble. But he was too tired, too drained, too plain frightened even to think about that.

His eyes smarted briefly as he painstakingly vacuumed the dust off his suit. Ozone, from the superoxides in the soil, he knew. We could keep ourselves supplied with oxygen just by dumping some of the red dirt in here, he told himself.

Once out of the suit, he went up to the cockpit and stared out at the darkening landscape, feeling his insides fluttering. I'm scared, Dex said to himself. Like

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a kid afraid of the dark. Scared. Wiley's as calm as can be and I'm falling apart. Shit!

With nothing better to do, he checked the communications file for incoming messages. The usual garbage from the base, plenty of satellite data about the approaching storm. And a message marked personal for him.

Only one person in the solar system would be sending me a personal message, Dex thought. With a mixture of anger and relief he tapped the proper keys and saw his father's glowering skull-like face appear on the rover's control panel screen.

Just what I need, he thought. Comic relief from dear old Dad.

"Well," Jamie said to the five of them, "we're as ready for the storm as we can be."

"So are Possum and Dex," said Stacy Dezhurova.

"He wants to be called Wiley," Jamie reminded her.

Dezhurova sighed dramatically. "The male ego. Perhaps I should change my name, too."

They were sitting around the galley table, picking at their dinner trays. No one seemed to have much of an appetite, despite the hard labor they had put in getting ready for the storm.

Vijay asked lightly, "What name would you choose for yourself, Stacy?"

"Not Anastasia," Dezhurova answered quickly. "And not Nastasia, either. It's too . . . complicated."

"I think Anastasia's a pretty name," Rodriguez said. "I like it."

"Then you can have it," Dezhurova said.

They all laughed. Nervously.

Jamie wondered if he should tell them about Trumball's move to replace him as mission director. It affects them as much as it does me. More, in fact.

Yet he remained silent, unready to burden them with the political maneuverings going on back on Earth. That's a different world, Jamie said to himself. We've got our own problems to face here, our own realities.

It all seemed so unreal to him, so remote and intangible. Like the ghost stories his grandfather would make up for him when he was a child. Like the legends of First Man and First Woman when the world was new.

This is the new world, he realized. Mars. New and clean and full of mysteries. I can't let Dex and his father turn it into a tourist center. I can't let them start to ruin this world the way they destroyed the world of the People. That's why I've got to fight them.

A new understanding flooded through him. It was as if he'd been lost in a trackless wilderness and suddenly a path opened up before his eyes, the path to harmony and beauty and safety.

I can't let them bring tourists here. I can't let them start to tear up the natural environment so they can build cities and hotels. Bring climbers to Olympus Mons. Build ski runs. I've got to fight them. But how?

"Listen to that!"

Jamie's attention snapped back to the galley, the dome and his five fellow explorers. The wind had keyed up to a higher pitch. He watched their five faces as they stared up into the shadows of the dome. Something creaked ominously.

"The dome is perfectly safe," Fuchida said to no one in particular. "It was designed to withstand the highest winds ever recorded on Mars, with a huge safety factor added in."

"Then what made that noise?" Trudy Hall asked, her voice small and hollow.

"The dome will flex a little," Jamie told them. "Nothing to worry about."

"Really?" Trudy seemed utterly unconvinced.

Jamie made a smile for her. "Really. In fact, if it didn't flex, if it was built to remain totally rigid, it might crack under a high-enough wind load."

"Like the mighty oak and the little sapling," Vijay said.

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"Oh, yes, I know that one," Hall said, looking slightly relieved. "The oak stands firm against the hurricane and gets knocked down, while the sapling bends with the wind and survives."

"Exactly."

Dezhurova pushed up from the table. "I'm going to check the outside camera views and see if the dust is obscuring them yet."

"Good idea," said Jamie. He got to his feet, too. "I'll put in a call to Wiley and Dex, check on how they're doing."

Vijay turned to Fuchida. "How does your ankle feel?"

"Not bad," the biologist replied. "I can walk on it without much pain."

"Then let's check out the garden one more time before going to bed."

Jamie thought Stacy suppressed a smirk at Vijay's mention of bed.

Rodriguez got up from the table. "Come on, Trudy. I'll play you a round of *Space Battle*."

"Not with you, Tommy. You're a shark. Besides, I won't be able to concentrate on the game with this storm on top of us."

Rodriguez went around to her chair. "Come on, I'll give you ten thousand points handicap. It'll be fun. Take your mind off the storm."

She got up. Reluctantly, Jamie thought.

Jamie felt glad that their electrical power came from the nuclear generator, which would not be affected by the storm. He followed Stacy to the comm center, forcing himself not to turn back to look at Vijay.

As Dex stared at the blank screen on the rover's control panel, he could still see his father's image, like the retinal glow of a flashbulb or the lingering presence of a powerful genie.

He wants to dump Jamie, Dex said to himself. He wants to dump Jamie, but he didn't say a word about who he wants to take Jamie's place.

Dex sank back in the cushioned chair, his mind spinning. Could I do it? The answer came to him immediately. Certainly I could do it. I could head this operation without any trouble. But would the others listen to me? Especially if they think I pulled strings with my father to knock Jamie off.

This is tricky, he realized. The thought of being named mission director filled Dex with a warm flush of pride. They'd listen to me. They'd have to. After all, it won't be just my father who picks me; the whole ICU board would have to vote on it. Probably they'd want a unanimous vote.

But would Dad put me in charge? Does he trust me that much? Or would it be just another one of his ways to keep me under his thumb?

Jesus H. Christ, he swore. I'm on friggin' Mars and he's still got me jumping through his goddamned hoops!

Craig came stomping in through the airlock hatch.

"Gettin' dusty out there," he said, once he lifted the visor of his helmet.

Dex started to get up from his seat, but Craig called back, "I'm OK. It'll just take me a little time to vacuum all this crud off th' suit."

Dex went back anyway and helped him out of the backpack. It too was covered with a thin sheen of pinkish powder. Even Craig's helmet was tainted.

"We're going to get buried in this stuff," he heard himself say. He wished his voice didn't sound so shaky.

"Looks that way," Craig said easily. "Th' covers on the solar panels are holdin' down good, though. Wind might be makin' a lotta noise, but there's not much punch in her."

"That's good."

They were just starting to eat their dinners when the comm unit buzzed. Dex got up and went to the cockpit. He slid into the driver's seat and tapped the ON key.

Jamie Waterman's coppery-red serious face filled the panel screen. "Hello, Dex. How are you two doing?"

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"Just having dinner, chief."

Jamie said, "It's starting to blow here. According to the latest met report, you'll be in the storm at least through tomorrow."

Dex nodded. He had seen the meteorology report; studied it hard.

"How are the batteries performing?" Jamie asked.

"We're still on the fuel cells. Wiley decided to run them to exhaustion before we go to the batteries."

"Smart move."

"What's happening there?"

Jamie seemed to think it over for a few moments. "We're in good shape. We've got everything battened down. It's going to be a noisy night, though."

Despite himself, Dex gave a snorting, derisive laugh. "Tell me about it."

"Your telemetry is coming through all right," Jamie said. "We're getting good data from you."

"Fine."

"The transmission will probably degrade as dust piles up on your antennas, though."

"I know." Dex started to feel a tendril of exasperation. Jamie's just talking to hear himself talk, he thought.

"I can't think of anything else we can do for you," he said. "I wish I'd ordered you to stay at the generator."

Dex suppressed an urge to say, *Me too.* Instead, he leaned closer to Jamie's image on the display screen and said as cheerfully as he could, "We're doing fine out here. And when the storm clears up we'll be that much closer to the Pathfinder site."

Again Jamie was silent for several maddening moments. At last he said, "It's too late to worry about what might have been. Good luck, Dex. Give Wiley my best wishes."

"Right. We'll call you in the morning."

"If the antennas are still functioning," Jamie said.

"We'll clean them off if they're covered with dust," Dex replied, sharply.

"Good. OK. Goodnight."

"Goodnight." Dex punched the OFF key. Christ, he looks like he doesn't expect to see us again.

Then he thought, Maybe that's what Jamie wants. Get me out of his hair. No, he's not like that. But it's exactly how *I'd* feel if our situation was reversed.

To his surprise, it was Rodriguez who could not keep his mind on the *Space Battle* game. Time and again he focused his concentration on the computer screen, but his attention wandered with every shriek of the wind outside. The dome seemed to creak and groan like an old wooden sailing ship in a gale; Rodriguez almost thought he could feel the floor shuddering and pitching.

He and Trudy Hall sat side by side in her bio lab, with two high-speed joysticks plugged into the beeping, chattering computer. The screen showed sleek space battlecraft maneuvering wildly against a background of stars and planets while they zapped at each other with laser beams. Ships exploded with great roars of sound.

Finally, when he had lost the third round of the computer game, Rodriguez pushed his chair back and said, "That's enough. I quit."

"You let me win," Trudy said. There was more delight in her smiling expression than accusation.

He shook his head vehemently. "Naw. I was trying. I just couldn't concentrate."

"Really?"

Rodriguez's shoulders drooped. "Really."

"Worried about the storm?"

"It's kinda silly, I know. But yeah, it's got me spooked . . . a little."

"Me too," Hall admitted.

"You sure don't look it," he said, surprised. "You look calm as a cucumber."

"On the outside. Inside I'm as jumpy as . . . as . . ."

"As a flea on a hot griddle?"

She laughed. "What a ghastly idea."

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He got to his feet. "Come on, I'll buy you a cup of coffee. Or maybe you prefer tea."

She stood up beside him, slim and spare next to his solid, chunky build. They were almost the same height, though, and her dark brown hair was only a shade lighter than his.

"Actually, I still have a drop or two of good brown sherry in my quarters."

Rodriguez's brows rose. "We're not supposed to take any liquor—"

"It's left over from our landing party. Should have finished it then, I suppose, but I saved a bit for a possible emergency."

"Yeah, but . . ."

"This counts as an emergency, don't you think?"

Inadvertently, Rodriguez glanced up into the shadowy height of the darkened dome. The wind moaned outside.

"There's not enough to make anyone drunk, you realize," Hall said. "Just a bit to take the edge off, you know."

He looked back at her and saw the fear and helplessness in her eyes. She's just as scared as I am, he told himself. She feels just the way I do.

"OK," he said.

"Come on, then," Trudy said, holding her hand out to him. "Walk me home."

He took her hand. Then as they walked through the empty shadows of the dome, with the wind howling now and the structure making deeper, stranger noises of its own, he slid his arm around her waist. She leaned her head against his shoulder and they walked together toward her cubicle and a night when neither of them wanted to be alone.

Stacy Dezhurova was staring hard at the display screens, watching how the wind was fluttering the tied-down wings of the soarplanes. The wings of the bigger, heavier rocketplane were also undulating noticeably, straining against the tie-downs fastened to the ground.

"We've done all we can, Stacy," said Jamie, behind her. "You ought to get some sleep now."

"But if one of the planes breaks loose . . ."

"What can we do about it?" he asked gently. "We parked them downwind of the dome. If they break loose, at least they won't come crashing in here."

She nodded, but kept her eyes glued to the screens.

"Stacy, do I have to *order* you to your quarters?"

Dezhurova turned and looked up at him. "Someone ought to stay on duty. Just in case."

"OK," Jamie said. "I will. Go get some sleep."

"No. I couldn't sleep anyway. I'll stay."

Jamie pulled up the other wheeled chair and sat next to her. "Stacy . . . we're going to need you tomorrow, bright-eyed and bushy-tailed, rested and able to perform at your best."

She looked away from him briefly. Then, jabbing a finger at the digital clock next to the main display screen, she said, "It's twenty-one-fifteen, almost. I'll stay here until oh-two hundred. Then you can come on until six. That will give each of us four hours' sleep. OK?"

"One A.M.," Jamie said.

Her serious expression did not change at all as she asked, "Will that give you and Vijay enough time?"

Jamie felt his jaw drop open.

Dezhurova laughed. "Go on. Set your alarm for one. Then you can relieve me."

Jamie got up from the chair thinking, Stacy could take the director's job. She'd be good at it.

Vijay was sitting at the galley table when Jamie left the comm center. He walked straight to her and she looked up at him with her big, soulful eyes filled with—what? he wondered. Anxiety? Loneliness? Fear?

And what's in my eyes, Jamie wondered as he extended his hand toward her. She took it in hers, rose from her chair, and walked wordlessly with him

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toward his quarters. What am I doing? Jamie asked himself. This isn't love. This isn't the kind of romantic moment that poets write about. It's need; we need each other. We're scared of this storm, of being so far from home, so far from safety. We need the comfort of another person, someone to hold on to, someone to hold me.

They said hardly a word to each other as they stripped and got into Jamie's narrow bunk. Their lovemaking was torrid, as if all the rage and power of the storm had possessed them both. The first time, ten nights ago, they had taken pains to be as quiet as possible. Not this night. Not with the wind wailing outside. Now they lay, languid, spent, thoughts drifting idly, all barriers down, all furies calmed.

Should I tell her about Trumball? he asked himself. There was no urgency in the thought. It simply rose to his consciousness dreamily, like a whisper struggling through a drug-induced haze.

Jamie kissed Vijay's bare shoulder; she muttered something sleepily and snuggled closer to him. As he drifted toward sleep with Vijay's body warm and softly cupped next to him, he knew he would feel empty and alone without her. And afraid.

Sharp, cold reality stabbed through him. You can't talk about love. You can't even think about it. Not here. Not under these conditions. You made that mistake last time and it brought nothing but pain to you and her. You can't expect Vijay to commit her life to you on the basis of what we're doing here.

Which means, he heard himself reason, that you can't burden her with your problem about Trumball. It's your problem, not hers. You've got to find the right path for yourself, alone.

Jamie turned slightly in the bunk and looked over at the glowing red numerals of the digital clock. Get some sleep. It's going to be one a.m. damned soon.

* * *

It was nearly midnight as Stacy returned to her chair in the comm center and set a plastic cup of hot tea on the console beside the main display screen. The wind was screeching outside, a thin tortured wail like the distant howl of souls in hell. Wearily she started checking all the dome's environmental systems again.

With deliberate calm, Dezhurova tapped into the environmental monitoring display. Everything was normal in the dome, except for one of the air-circulation fans, which had gone offline earlier in the day. She would attend to that in the morning, she told herself.

She opened the program for the sensors that monitored environmental conditions in the garden bubble. Before she could check them, though, the yellow light on the main communications console began blinking and her screen showed: INCOMING MESSAGE.

She grumbled to herself as she tapped at the keyboard. What does Tarawa want now?

To her surprise, it wasn't mission control at Tarawa. Her comm screen showed a bleary-eyed, tousle-haired Dex Trumball.

Dex could not sleep.

He lay in his bunk listening to the wind shrieking just inches away, hearing the iron-rich sand scratching at the rover's thin metal skin, *feeling* the storm clawing at the rover, trying to find a way inside, a loose latch, a slight seam, the tiniest of openings in the welds that held the rover's skin together.

We could be dead in a minute, he knew. Or worse, buried alive under the sand with the electrical power gone. Strangled to death when the air gives out.

And we can't do anything about it! Just lie here and take it. Let the friggin' storm pound us and batter at us until it finds a way to kill us.

He sat up abruptly, heart racing, chest

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heaving. He felt sweaty and cold at the same time. He had to urinate again.

Peering through the darkness, he could make out in the faint glow from the instrument panel up in the cockpit the lumpy form of Craig, sleeping in the bunk on the other side of the module. Craig lay on his back, mouth slightly open, snoring gently.

Christ, he's as relaxed as a baby in its cradle, Trumball thought as he slipped quietly out of his bunk.

He padded barefoot to the lavatory, opposite the racks where the hard suits stood like ghosts in armor. Fear fills the bladder, Dex told himself as he urinated into the stainless steel toilet bowl. This motherfucking storm's scaring the piss out of me. It was his fourth trip to the toilet since he had gone to bed.

"You all right, buddy?" Craig asked softly as he crawled back into his bunk.

"Yeah," Dex snapped. "I'm fine."

"Kinda noisy out there, ain't it?"

"It sure is."

"Don't let it spook you, kid. We're safe as can be inside here."

Dex knew Craig was trying to reassure him, calm him. He knew he should be grateful to Wiley. Instead he felt angry that the older man had called him 'kid.' And ashamed to be caught in his terror.

The wind quieted a bit. The shrieking softened. Maybe it's over, Dex thought. Maybe it's winding down.

He lay back on his sweat-soaked pillow and closed his eyes again. But the instant he did, the wind gusted again with a furious scream. Dex felt the rover rock.

He bolted up to a sitting position and pounded the mattress with both fists, almost sobbing. Leave me alone! Leave me alone! Go away and leave me alone, please, please, please.

The wind continued to howl, though. If anything, it got louder.

Blearily, he shuffled up to the rover's cockpit and slumped into the right-hand seat. Let's see what's happening at the dome. Talk to somebody. Anybody. Take your mind off this mother-humpin' storm.

Stacy's stolid, fleshy face filled the tiny screen on the control panel. The picture was streaked, grainy, but she looked surprised.

"Dex?"

"Yeah," he said softly, not wanting to wake Craig again. "Too noisy out here to sleep. How's everything there?"

Dezhurova spoke with Dex for a few seconds, then realized that Trumball merely wanted to chat because he could not sleep in the midst of the storm. Reception was weak; his video kept breaking up. Probably dust is piling up on his antennas, she thought. She kept on talking with him, but turned her real attention to the monitoring screens and continued checking the environmental conditions in the garden bubble.

Temperature below nominal, she saw. That should not be. Air pressure was falling too.

Her breath caught in her throat. Without even thinking about Dex, still jabbering on the main comm screen, Stacy grabbed the loudspeaker mike and bellowed:

"Emergency! The garden dome is ripping apart!"

Dex gaped at the tiny comm screen.

"Jamie, everyone—the garden dome is ripping apart!" Dezhurova repeated, roaring like the crack of doom. "We need everyone, right now!"

Then the comm screen went dark.

Dex sat in the rover's cockpit, icy sweat trickling down his ribs, staring at the dead comm screen.

My god almighty, he thought, panting with mounting terror as he sat in the shadows. If the garden bubble goes, the main dome could go too. Then we'd all be dead.

Mitsuo Fuchida lay in his bunk, staring up into the darkness, listening to the

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wind and the accompanying creaks and groans of the dome.

It's like being on a ship at sea, he said to himself, except that it doesn't rock.

He had considered taking a tranquilizer before going to bed, but decided that he would not need one. He had looked death in the face, back at the lava tube on Olympus Mons. This wind storm held no more terrors for him. Death will come or not, he thought. What cannot be controlled must be accepted.

Still, he lay awake listening to the storm.

Until he heard Stacy's shout: "Emergency! The garden dome is ripping apart! We need everyone, right now!"

Automatically he leaped out of bed, a stab of pain from his injured ankle shooting through his leg. Awkward with the bandaged ankle, Fuchida limped to the comm center. Jamie, Vijay, Rodriguez and Trudy Hall were also hurrying there, each of them hastily pulling on rumpled coveralls as they ran.

"The garden dome has been punctured," Stacy said, jabbing a thick finger at the monitor screen.

"Camera view," Jamie snapped, slipping into the wheeled chair beside her.

He peered at the screen. "Can't see anything—wait, the dome fabric is rippling."

"Pressure and temperature both falling rapidly," Dezhurova said, an unaccustomed edge of fear in her voice.

"The plants will die!" Trudy was saying, her voice pitched high, frightened. "The nighttime temperature—"

"I know, I know," Jamie snapped. Turning toward Rodriguez, he said, "We have spare cans of epoxy, don't we? Where are they?"

Rodriguez bent over one of the unused consoles and punched at its keyboard, then started scrolling through a list so fast it looked like a blur.

He saw what he wanted and froze the display. "Repair epoxy," he said, pointing to the screen. "It's stored in locker seventeen, A shelf."

"Go get it," Jamie commanded. "As much as you can carry."

Rodriguez brushed past Fuchida as he raced out of the comm center, staggering the limping biologist. Vijay headed out, too. "I'll help Tommy," she called over her shoulder.

Jamie jumped up from his chair. "Stacy, get suited up. Trudy, you help her. Mitsuo, take over the comm chair."

"Where are you going?" Stacy demanded.

As he rushed out into the dome's dimly-lit central area, Jamie said, "We've got to slap some temporary patches on the holes in the dome, if they're not already too bad."

"You can't go in there!" Trudy yelped.

"Somebody's got to stop the leak before it gets worse."

"Wait for Tomas," Dezhurova said. "The epoxy—"

"No time!" Jamie snapped, sprinting away from them. He headed for the airlock as they yelled after him.

"Get Stacy suited up!" he yelled back. "Mitsuo! Turn on all the lights in there!"

The dome flared into daytime brightness as Jamie reached the airlock that connected to the garden. Not in here, Mitsuo, Jamie corrected silently. In the garden, for the sake of Christ!

The pressure on the other side of the airlock had not fallen so low that the lock automatically sealed, Jamie realized as he pushed through the double hatches. Not yet, he told himself.

It was cold inside the garden. Jamie shivered involuntarily as he stepped in. The wind shrieked louder and the dome fabric was flapping noisily, like a sail luffing in the breeze. At least the full-spectrum sunlamps were on. Mitsuo heard me after all.

The emergency patches were stored in a closed box next to the airlock hatch. Tearing it open and grabbing a double handful of the thin plastic sheets, Jamie thought that they should have learned their lesson from the first expedition and scattered the sheets on the

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floor around the dome's perimeter.

Now he released them and saw them flutter in the air currents, then slap themselves against a pair of puncture holes on the far side of the dome.

Rodriguez boiled through the hatch, a big spraycan of epoxy in each hand. He looked like a two-gun frontier sheriff, grim and determined.

"I'll take them," Jamie said over the shrieking wind. "No sense both of us risking—"

"You're not gonna be the only hero tonight," Rodriguez said, pushing past Jamie and heading for the spots where the temporary patches were fluttering against the side of the dome.

Vijay stepped through with more cans. Jamie grabbed one from her and they both ran after Rodriguez.

The plants didn't look too bad, Jamie thought, glancing at the rows of hydroponics trays. But what the hell do I know? Green leaves, mostly curled tight. Are the ones closest to the rips drooping more than the others? Christ, some of them look gray!

"I think we got it sealed," Rodriguez said, after a furious few minutes of spraying.

Jamie looked around. The dome had stopped flapping. Fuchida must be pumping more air in here, keeping the pressure up. The wind outside sounded just as loud, maybe even louder, but now the dome's plastic structure seemed rigid, safe.

"Maybe you're right," he said cautiously.

"It's cold in here," Vijay said, hugging herself.

"Go and tell Mitsuo to goose up the heaters," Jamie instructed. "Tomas, let's spray the whole perimeter of the bubble, down here where the fabric joins with the flooring. If there's going to be any more problems, that's where they'll happen."

"Right," said Rodriguez.

Just then Dezhurova clomped in, buttoned up in her hard suit.

"We got it under control," Rodriguez shouted happily at her.

She raised her visor and glowered at him. Rodriguez laughed.

"Stacy," Jamie said, "I want you and Tomas to check the integrity of the dome. Spray anything that looks like a potential leak."

"The epoxy is not transparent. It will cut down on the sunshine the plants receive."

"That's OK. The lamps can make up for lack of sunlight, temporarily. The important thing is to ensure the dome's integrity."

Trudy Hall stepped through the airlock hatch: "Oh, my lord! The tomatoes are *ruined!*"

Jamie grabbed her by the arm. "Trudy, you and Mitsuo should check out all the plants, see how much damage has been done. I'll take over at the comm center."

"All right, certainly." She rushed to the trays of plants at the far side of the dome.

Jamie was still at the comm console when the sun finally came up and the others began to stir. The wind was still yowling outside, but with the sunrise the visibility outside improved somewhat. In the screens that showed the outside camera views Jamie could see that the planes were all still there, although one of the soarplane's wings seemed bent oddly. One of the cameras had ceased functioning, but otherwise everything seemed to be in reasonably good shape.

Red sky at morning, he thought.

"Want some coffee?"

It was Vijay, standing at the comm center doorway with a steaming mug in her hands.

"Good idea," said Jamie, reaching for it.

"How is everything?" she asked, sliding into the chair next to his.

"We're in reasonably good shape."

"How much damage to the garden was there?"

"Trudy was almost in tears over the

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tomatoes and some of the soybeans, but most of the plants are all right. We caught the leak in time."

"We won't have to pack up and go home, then?"

He shook his head slowly. "No. We might have to go without soyburgers for a while, but the garden will still feed us."

"That was a very brave thing you did, dashing in there like that."

Jamie felt his brows hike up. He didn't feel very brave. With a shrug he replied, "Seemed like the right thing to do. We had to get those patches in place."

"You could have been killed."

"I never even thought of that," he confessed. "It all happened so fast . . . "

"You're a bloody hero, Jamie." She wasn't joking, he saw. She was in dead earnest.

Feeling suddenly uncomfortable, Jamie changed the subject. "I haven't been able to raise Dex and Wiley yet."

"You expected that, din't you?"

He nodded. "Probably a lot of dust on their antennas by now. We'll just have to be patient."

"You're good at that," she said, with a smile.

He caught her implication. "It's a lot more fun being patient with you than with them," he said, low and swift, afraid of being overheard.

Before she could reply, Rodriguez burst in, white teeth gleaming in a huge grin. "Well, we made it through the night," he said, then burst into a hearty laughter.

Jamie threw a perplexed glance at Vijay, who shrugged her shoulders.

"You were terrific, boss," the astronaut said, beaming at Jamie. "Saved our necks, man."

Jamie shook his head, but Vijay nodded agreement. "If the garden had gone, we'd have to pack up and leave, wouldn't we?"

"Maybe," Jamie conceded. "Anyway, the garden's going to be all right. So let's get on with the program, OK?"

"Right!" Rodriguez said. "You had breakfast yet, boss? I'm hungry enough to eat a Martian buffalo."

From the doorway, Stacy Dezhurova snapped, "You'll have to find one first, Tomas."

"Lemme grab some juice," Rodriguez said, still grinning buoyantly, "then I'll spell you at the console while you guys grab breakfast."

"I thought you were starving," Jamie said, getting up from the chair.

"Yeah, I know, but I can wait. You guys go eat. I'll hold the fort here."

Jamie looked to Dezhurova, who said, "I'll get your juice, Tomas."

"OK, thanks."

Jamie said. "Well, if you're going to take over, see if you can raise Craig and Dex."

"Right." Rodriguez sat heavily on the little chair, making it roll away from the console a few feet.

As he went to the galley with Vijay and Dezhurova, Jamie wondered aloud, "Tomas sure is chipper this morning. He must have had a good restful sleep."

Dezhurova sputtered into laughter. "Not exactly."

"What do you mean?"

Stacy looked up into Jamie's face. "Didn't you hear them? Him and Trudy? They were at it all night long."

Inadvertently, Jamie glanced at Vijay, who was trying to suppress a smirk.

"At least you two are quiet about it," Stacy went on, matter-of-factly. "My cubicle is next to Trudy's. Tom was snorting all night like Ferdinand the Bull. He even drowned out the storm."

Vijay broke out in laughter.

They had just started to eat breakfast when Fuchida limped up to the table, looking distressed.

"What's wrong, Mitsuo?" Jamie asked.

"Am I the only one who wonders why the garden dome began to rip apart?" he asked.

"What do you mean?"

The biologist sat across from Jamie and Vijay and propped his bandaged ankle on an empty chair.

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"How can the dust rip the bubble fabric?" he asked, like a professor posing a problem for his class.

Dezhurova got up from the table. "I promised Tomas I would bring him juice," she remembered. "He probably needs it."

Fuchida did not catch her insinuation. "The bubble's plastic cannot be punctured by dust particles," he said quietly, firmly. "Yet the fabric was punctured."

"I thought it ripped along the base where it connects with the flooring," Jamie said.

"No," Fuchida replied, raising one finger for emphasis. "There are two small punctures. If not repaired so quickly, they would have grown into a rip that would have torn the entire dome off its foundation."

"But we did catch it in time," Vijay said. "Jamie did, that is."

Fuchida acknowledged the fact with a small dip of his chin. "Still, we must ask how the dome was punctured."

Jamie suggested, "Small rocks blown by the wind?"

"I doubt it," the biologist said.

"Then how?"

"I don't know. But it troubles me. The dome should not have failed. That plastic fabric has been tested under much more severe conditions in laboratory simulations. It should not have failed."

"Yet it did," Vijay said, almost in a whisper.

"It did indeed." Fuchida looked like a prosecuting attorney to Jamie. Suspicious, almost angry.

"Well," Jamie said, "I don't know how it failed, but we ought to figure out some way of making certain it doesn't happen again."

"Hey buddy," Craig said cheerfully, "we made it through the night."

From across the narrow table between their bunks, Dex nodded glumly. He felt exhausted, sleepless eyes gummy, coveralls rumpled and stinking of fear.

The wind was still screeching outside. Particles of iron-cored grit were still grinding against the rover's thin skin, like an endless army of soldier ants working tirelessly to break through their defenses and come in and devour them.

"Communications're out, of course," Craig added.

"Of course," said Dex blearily.

"Soon's the wind dies down to less'n a hundred knots we'll go outside and dust off the antennas. Squirt a signal back to base, let 'em know we're OK."

"If they're OK," Dex replied gloomily.

"They'll be all right," said Craig. "That big dome's built like the Rock of Gibraltar. Been through dust storms before, y'know. Been settin' out there more'n six years, after all."

"I suppose so," Dex admitted.

Unbidden, his mind was cataloguing all the things that might not be OK. If the covers had ripped off during the night, the solar cells could be scratched and pitted so badly they'd be useless. The fuel cells were already down to zero; they were living off the batteries. The gritty dust could have worked its way into the wheel bearings, immobilizing them completely. Then we'll have a choice of starving or suffocating, Dex thought. Or the dust could have scoured the antennas so badly their comm systems would be completely shot. Then we couldn't navigate, couldn't get positioning data from the satellites, we'd be lost out here forever.

Or the whole frigging base dome might have blown down during the night, he added.

"Hey!" Craig snapped. "You listenin'?"

"Sorry," Dex said, trying to sit up a little straighter.

"I said we'd better stick to a cold breakfast. No sense drainin' the batteries by usin' the microwave."

"I'll get breakfast," Dex said, pushing himself up from his bunk. "You can do the systems check."

"Already did that. After breakfast we power down. Shut off the freezer, let it

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coast; food'll keep cold inside OK. Air fans on low. Lights to minimum. Until we get the solar panels uncovered and workin' again."

"If they'll work again," Dex muttered as he went back to the compact stand of racks that served as the rover's galley.

"Didn't get much sleep last night, huh?"

"How'd you guess?" Dex pulled out the first two cereal packages he could reach.

"Listen, kid, the worst is over. Storm's peterin' out now. In another couple hours—"

Dex whirled on him. "You listen, pal! You don't like being called Possum? Well, I don't like being called kid. Got that?"

"Then stop behavin' like a kid," Craig shot back, scowling.

Dex started to reply, but found he had no answer for the older man.

"You're scared, OK. I am too. What th' hell, we're stranded out here in the middle of downtown Mars. For all I know we're covered with sand twelve feet deep and ever'body in the base is dead. OK! We'll have to deal with that. You do what you can do. You don't sit around mopin' and grumblin' like some teenager with an acne problem."

Despite himself, Dex laughed. "Is that what I've been doing?"

Still sitting on his bunk, Craig's leathery face rearranged itself into a small smile. He nodded. "Sort of," he said.

"I'm scared, Wiley," he admitted. "I don't want to die out here."

"Shit, buddy, I don't want to die *at all*."

As he put both cereal packages on the table, Dex said, "Maybe we ought to go outside and see how bad the damage is."

"Still blowin' pretty strong out there. Be better to wait a couple hours."

"I'll go nuts sitting in here with nothing to do but listen to that wind."

Craig nodded. "H'm. Yeah, me too."

"So?"

"So let's have us a nice leisurely breakfast and then take our time suitin' up."

"Good," said Dex, feeling some of the fear ease away. Not all of it. But he felt better than he had during the night.

"Not as bad as it could've been," Craig pronounced. But his voice sounded heavy, unhappy, in Dex's earphones.

The sky was still gray, sullen. The wind was still keening, although nowhere near as loud as it had been. Dex was surprised that inside the hard suit he felt no push from the wind at all. He had expected to have to lean over hard and force himself forward, like a man struggling through a gale. Instead, the thin Martian air might just as well have been totally calm.

On one side the rover was half buried in rust-red sand. From the nose of the cockpit to the tail of the jointed vehicle's third segment, the sand had piled up as high as the roof on the windward side.

"Good thing the hatch was on the leeward side," Dex said. "We might've had trouble getting it open if it was buried in this stuff."

"Naw, I don't think so," Craig answered, kicking at the pile. Dust flew like ashes, or like dry autumn leaves when a child scuffs at them.

"Maybe."

"Besides," Craig added, "I turned her so the hatch'd be on the sheltered side when we stopped for the night."

Dex blinked inside his helmet, trying to remember if he was driving then or Craig. Wiley's not above taking credit for good luck, he thought.

"Come on, let's see what's happened topside."

As they trudged around the rover, back to the side that was almost free of the dust, Dex could see that at least part of the makeshift coverings they had taped down over the solar panels had been blown loose. One sheet was flapping fitfully in the wind.

As Craig climbed up the ladder next to the airlock hatch to inspect the solar

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panels, Dex caught sight of the most beautiful apparition he had seen on Mars: the dull gray dust-laden clouds thinned enough, for a few moments, for him to see the bright pink sky overhead. His heart leaped inside him. The storm's breaking up! It's breaking up at last.

"Worse than I hoped for," Craig's voice grated in his earphones, "but better'n I was scared of."

Craig came down from the ladder. "We got some scratches and pittin' up there where the tarp came loose. The rest of the panels look OK, though."

"Good," said Dex, suddenly enthusiastic. "Listen, Wiley, I'm going to duck back inside and put on the VR rig. Nobody's ever recorded a Martian dust storm before. This'll make great viewing back home!"

He heard Craig chuckling inside his helmet. Then the older man said, "Startin' to get some of your spirit back on-line, huh?"

"I . . . " Dex stopped, perplexed for a moment. Then he put a gloved hand on the shoulder of Craig's suit. "Wiley, you really helped me. I was scared shitless back there, and you pulled me through it."

"You did it for yourself," Craig said, "but I'll be glad to take the credit for it."

Dex felt his insides go hollow.

As if he sensed it, Craig said, "Don't worry, son. What happened here is between you and me, nobody else."

"Thanks, Wiley." The words sounded pitifully weak to Dex, compared to the enormous rush of gratitude and respect that he felt.

"OK," Craig said gruffly. "Now before you start doin' your VR stuff, let's get the antennas cleaned off so we can tell Jamie and the gang that we're OK."

Rodriguez gave a sudden whoop from the comm center.

"Wiley's calling in!"

Jamie bolted up from the galley table while Vijay stayed to help the limping Fuchida. In the comm center Jamie saw Craig's scruffy-bearded face on the main screen. " . . . solar panel output's degraded by four-five percent," Craig was reporting. "Coulda been a lot worse."

"What about the fuel cells?" Rodriguez asked.

"Dex's electrolyzing our extra water; gonna feed the hydrogen and oxy to 'em. That way we can rest the batteries."

Poking his head into the comm camera's view, Jamie asked, "Do you have to dig yourselves out?"

Craig looked very pleased. "Nope. The wheels and drive motors are all OK. We just put 'er in gear and pulled ourselves loose. We're movin' now."

"Wow!" Rodriguez exclaimed.

"That's great," said Jamie, feeling genuinely pleased and relieved. "That's just great, Wiley."

"Oughta be at Ares Vallis in another three-four days," Craig said. Then he added, "If the weather holds up."

Rodriguez laughed. "There's not another storm in sight."

"Good."

When Craig signed off, Rodriguez began checking the telemetry from the rover and Jamie went back to the inventory list. The wind was still yowling outside like dead spirits begging to come in out of the cold.

Jamie was tired, physically and emotionally drained, as he made his way back to the comm center for what must have been the hundredth time that day.

As the storm wound down, he had spent most of the day in the greenhouse bubble, checking and rechecking the area that had been damaged. He had even suited up and gone outside to inspect the damaged areas without the emergency patches and epoxy covering them. It was hard to say, but the areas seemed to have been punctured, not torn. Of course, once punctured the plastic fabric began to rip along the seam where it connected to the foundation of the dome.

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What we need here is a forensic structural engineer, Jamie told himself. If there is such a person. Maybe Wiley could make some sense of it.

He took dozens of photographs of the damaged areas and transmitted them back to Tarawa for their analysis. There was nothing more he could think to do, but he kept feeling that he was missing something. Something important.

What is it, grandfather? he asked silently. What have I overlooked?

Once in the comm center he slumped down on the little chair and put through another message to Tarawa.

"Pete: The greenhouse dome looks OK now, but I'm worried about what might happen in the next storm. Maybe that won't be for another year, but it's a problem we ought to think about now, not when the dust starts blowing again. It's obvious that we overlooked this problem, but with twenty-twenty hindsight I think we ought to pay attention to it.

"Can you get the world's assembled experts to figure out how we can protect the greenhouse bubble with the materials we have on hand? That includes native Martian materials, of course. What I'm wondering is, can we make glass bricks out of the Martian sand? Build an igloo that's transparent? Look into it for me, will you?"

The wind died down almost completely after sunset. Jamie was tempted to put on a suit and go out to see if the stars were still in their places, but he felt too tired. The outside cameras showed that the planes were still there, although what condition their solar panels might be in would have to wait for a closer inspection.

The dome was quiet, back to normal, when Jamie finally went to his quarters. Vijay was already there, in the bunk. He blinked with surprise.

"Tomas is bunking with Trudy," she said, matter-of-factly.

Nodding, Jamie muttered, "I wonder if Mitsuo and Stacy are going to get it on?"

Vijay giggled softly. "Not bloody likely."

"Why not?"

"Stacy's gay."

Jamie's eyes popped open. "What?"

"Stacy's a lesbian."

There's nothing wrong with that, Jamie told himself. Still, he felt shocked.

"Poor Mitsuo," he heard himself whisper as he got under the covers beside her.

Vijay moved over to make room for him on the narrow bunk. "I don't know about him. He hasn't come on to any of the women."

"Maybe he's gay, too?"

"I doubt it. I think he's just got more self-control than you western ape-men."

Jamie wanted to debate the point, but instead he closed his eyes and fell instantly asleep. □

(Editor's Note: The action in this excerpt from Ben Bova's forthcoming novel, Return to Mars, *overlaps that in "Mount Olumpus," in our February 1999 issue.)*

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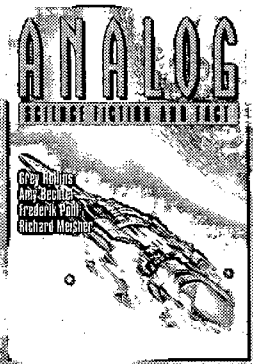

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THE REFERENCE LIBRARY Tom Easton

The Iron Bridge, David Morse, Harcourt Brace, $25, 436 + xii pp. (ISBN: 0-15-100259-2).

The History of Our World Beyond the Wave, R. E. Klein, Harcourt Brace, $22, 216 pp. (ISBN: 0-15-100411-0).

Missing Man, Michael Cassutt, TOR, $24.95, 349 pp. (ISBN: 0-312-86620-8).

Brute Orbits, George Zebrowski, Harper, $23, 222 pp. (ISBN: 0-06-105026-1).

Link, Walt Becker, William Morrow, $25, 388 pp. (ISBN: 0-688-15822-6).

Mission Child, Maureen F. McHugh, Avon, $20, 385 pp. (ISBN: 0-380-97456-8).

Hoare and the Portsmouth Atrocities, Wilder Perkins, St. Martin's, $20.95, 216 pp. (ISBN: 0-312-19283-5).

The Three Galileos: The Man, The Spacecraft, The Telescope, Cesare Barbieri, Jrgen H. Rahe, Torrence V. Johnson and Anita M. Sohus Kluwer Academic Publishers (ISBN: 0-7923-4861-3) *(Reviewed by Peter L. Manly).*

When I started teaching, my territory was biology. After all, I was a biologist! It didn't take long to start branching out, though. A seminar in science & public policy seemed a very natural step. Technical writing used my writing experience. Philosophy of science wasn't much of a leap, and an issues course was an easy segue (it led to a couple of books, too) which mutated into "Science & Technology in Society" with a big-shovel "Technology & Society" version and its companion "Legal & Ethical Dimensions of Technology" for a graduate program. (You can see syllabi, if you wish, at http://www2.thomas.edu/easton/.)

If I don't sound like a very pure biologist, that is surely because my mind was warped by John W. Campbell, Jr. I discovered him about the same time I discovered science fiction, in the late fifties. Ever since, it has seemed very natural to me to ignore boundaries between fields, to draw connections wherever one can find them, and to take risks in the process. Campbell went out on some very strange limbs at times. So do I, and sometimes, like Campbell, I wind up looking silly.

Or at least strange. My graduate students—mostly K-12 teachers getting a master's degree in Computer Technology Education—have turned David Nye's insistence that technology can be "sublime" into a running joke, for I have made several batches of them read his *American Technological Sublime* (reviewed here in December 1996). "Sublime?" they ask. "Well, yes, maybe, but what's that got to do with anything?"

I laughed when I found the word in Dávid Morse's **The Iron Bridge** (p. 429), for Morse too sees that "sublime" has an enormous amount to do with the development of technology. He begins with a future of ecological catastrophe, when civilization is shattered into enclaves, a few of which struggle to survive by harmonizing with nature even though they know the effort is surely futile—nature is too damaged, and the human predators are on the prowl for anyone with anything worth the taking. One such is Ecosophia, whose folk also struggle to understand how the world

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got into such a mess, blame "bottom-think" (corporate bottom-line decision-making, with little or no regard to the broader impacts of decisions) and "big" technology, and think that if only humanity could be turned aside from big tech, the world might be saved. It's worth a shot, they say. We couldn't possibly make things any worse. And we do have the ability—rather mystical, but what the heck—to chuck one of us back in time.

The chuckee is Maggie Foster. The target is the first of the great cast-iron bridges, built by Quaker iron-master Abraham Darby III over the Severn Gorge in England's Shropshire, heart of the eighteenth-century iron trade. Maggie arrives naked in the middle of an earthquake, finds a niche, gets acquainted with the rugged, rugged conditions of life at the time, and in due course infiltrates the Darby home, where she hopes to affect the bridge's design in such a way that it fails, thus depriving the industrial age of a successful example of the large-scale use of iron. But there are major political, economic, and even spiritual forces at work, and when she actually does make changes from the history she remembers—Abraham Darby's brother comes up with a new bridge design that anticipates a century of improvements in efficiency and grace—they bid fair to *accelerate* the very thing she wants to slow.

Technology, she learns, is not things, but people. It expresses human urges both high and low, and it cannot be stopped, for those urges will find expression, generally in the showiest, most spectacular, most sublime form possible. How then can the consequences—her devastated future—be avoided?

The key is people, says Morse. Like Darby, he is a Quaker. An idealist. One who struggles to change the way people think. Perhaps, he says, it might be possible to turn Maggie Foster's catastrophic future into a vision, and preach it, starting almost two centuries before Rachel Carson.

Unfortunately, this is the same time period when Thomas Malthus was warning of his own vision of the future. And we all know how much impact he had. His catastrophe was too far off, and there was no discernible movement toward it—indeed, we seemed until the 1960s to be getting ever further from it, thanks in part to technological advances in many areas, all of them improving people's conditions of life. Surely that would also work against a Quaker vision of technoindustrial restraint.

I think I will show this one to my next graduate class. Perhaps someone could get a term paper out of it. But first, I'll recommend *The Iron Bridge* to my fellow SF writers for a Nebula.

I won't be recommending R. E. Klein's **The History of Our World Beyond the Wave**. It has at its heart a similar sentiment, but it is far less reflective, less generous of soul, and more bigoted at core

The premise is that one day a huge wave sweeps over the world. The only remaining land is mountain tops, now islands. Civilization is gone, as are most people. One who remains is English teacher Paul Sant, whose wanderings reveal a realm of marvels—hyperevolved intelligent sharks on legs, the gugs; strange silvery fish that surely enjoy a link to those we see on the backs of certain cars; a mutable landscape and time; a slow gathering of congenial folks who are building a new and sane civilization until the squint-eyed man appears to lead them astray.

It's allegory, sure. It's even Revelationist Christian allegory (though far less deftly done than, say, C. S. Lewis's allegories). But what gripes me is Klein's insistence on an arbitrary, senseless, irrational cosmos, on classic literature as the only thing worthy of attention, and on identifying the foe as "You and your kind, with your sociology and other

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pseudosciences, getting us to believe we were insignificant parasites, empty of substance and spirit . . . . The old way is better." In other words, the Antichrist is the rationalist, the scientist. Life should, says Klein, be ruled by superstition and myth (though assorted engineering handbooks out of the library may be useful).

Somehow I don't expect that message to appeal to *Analog*'s readership.

Michael Cassutt must like taking chances. Five years ago, I reviewed his and Deke Slayton's *Deke! US Manned Space from Mercury to the Shuttle: The Autobiography of Deke Slayton*, in which he showed a certain enchantment with the astronauts, who definitely liked taking chances.

So what sort of chances does Cassutt take? Well, here's **Missing Man**, released in September 1998 with its story running from October 1998 through 1999. Its mode is very, very realistic, bolstered by NASA memos, and it concerns events that should be in the news right now. That they aren't (of course!) produces a certain cognitive dissonance in the reader which might be off-putting. The risk is thus that Cassutt's cracking good story might be unjustly ignored.

The tale begins in a T-38 over the Gulf of Mexico. Astronaut candidate Mark Koskinen is getting in his time in the back seat behind Joe Buerhle, chief of the astronaut office. Mark knows that Joe is normally a pretty steady flyer. But now he's hotdogging it. Mark is scared. Now he's losing control. Mark is terrified. Now he's yelling "Get out!" And Mark's training takes over; he ejects successfully while the plane dives into the sea.

Accident? That seems to be the line officialdom is prepared to take but Mark's not so sure. Joe was really awfully wiggy there! Now Mark's on the accident board, the body's already been cremated, Mark's poking around the wreckage of the plane, and he finds a scrap of Joe's flesh. He turns it over to the fellow from the National Transportation Safety Board, who hands it off to a coroner, who discovers it is chock full of high-test cocaine.

Murder? It's beginning to look that way, though officialdom vastly prefers the accident theory. Soon Mark and Joe's ex-girlfriend, Kelly Gessner, are wondering who might be the murderer, learning that several had motives, and scheming to smoke out the guilty party. That backfires when a shot aimed at Mark nails his girlfriend instead. On the other hand, it does lead to Mark heading for orbit to corral a lunatic astronaut.

Suspense, intrigue, romance, sex, excellent characters, and a portrait of NASA never glimpsed in the official press releases. *Analog* readers should love it.

So should Hollywood (where Cassutt does have connections as a producer and screenwriter, so . . .).

George Zebrowski is a thoughtful, stimulating writer who has been compared to Olaf Stapledon by no less than Arthur C. Clarke. Of course, Stapledon was much more given to the Grand View than to anything resembling plot. We see much the same pattern in Zebrowski's **Brute Orbits**.

The premise is intriguing: In the next century, we will capture asteroids, haul them into Earth orbit, mine them into hollow shells with convict labor, and then say, "Aha! Let's fill them full of our worst criminals, the ones we're wasting all those supermax prisons on, give them power supplies and food synthesizers, and boost them into cometary orbits. Out of sight, out of mind, no more problems, and oh, yes, let's have a hearty round of self-congratulation here, for no more will we have sadistic guards abusing helpless prisoners. At last! A humane penology!"

Not hardly. The initial idea is to fill a Rock with folks serving, say, thirty-year sentences and put it in an orbit that will

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bring them back to Earth in thirty years. Lifers get longer orbits. But it doesn't take long for folks to see the advantage in making sub-life orbits longer. Nor is there much delay in filling Rocks with protestors, academics with uncomforting messages, and even those who are more ill than evil.

Any penal system, says Zebrowski, breeds new crimes upon the prisoners. Yet this system does offer something others never have: The prisoners must construct a society all their own inside each Rock. They must learn to control their own and others' behavior; those who refuse to learn die, while the rest actually produce a very civil civil order.

Some of the time. Zebrowski follows a number of examples to show both successes and failures, and later, when finally the home society can spare some ethical regard for its outcasts, he tells us that most of the hundred Rocks sent out are now empty, their inhabitants died out. The remaining fifteen are something else again, and perhaps their response to the opportunity to return or stay or . . . should not surprise us. There's more than a small nod here to older systems that "transported" prisoners to Australia and Georgia, where they forged homes, societies, and their own sense of mission.

Thoughtful and stimulating. Well worth your attention. But it's not for action fans.

Walt Becker's **Link** is exciting, action-packed nonsense of the sort that shows so little respect for the facts of the real world that it can say things such as: "a round exploded in the side of his neck. The man stood, clutching his pierced aorta. . . ."

That was pretty near the end, when the crew of paleoanthropologists, international arms dealers, and assorted henchmen are fighting off drug cartels, the CIA, and each other in an effort to get their treasure of ancient extraterrestrial skeletons and technology out of Bolivia. But the nonsense began right off, when Becker solemnly assured me that the Dogon of Mali knew well ahead of modern science that Sirius has a heavy companion star. That delusion was debunked some twenty years ago by Ian Ridpath (see *Paranormal Borderlands of Science*, Kendrick Frazier, ed., Prometheus Books, 1981; on the 'Net, see also http://wheel.dcn.davis.ca.us/~btcarrol/skeptic/dogon.html).

Becker is clearly not alone in having failed to notice the debunk (see http://marlowe.wimsey.com/~rshand/streams/scripts/sirius.html and http://binky.paragon.co.uk/features/Paranormal_ft/dogonfeat.html). This is why pseudoscience lives on, as people find an interesting idea, glom onto it, and get excited. It's in print, so it must be true! If anyone says it isn't, they're just in denial, part of the conspiracy, and proof positive that this neat idea must be so!

To anyone who understands how science works, this sort of approach is hard to take in both nonfiction and fiction. Becker thus makes suspension of disbelief very difficult for, say, an *Analog* reader. Nor does he help when he gives us as a character an anthropologist who takes the idea of ancient astronauts seriously. And he demolishes whatever credibility remains when he says that the demonstration that ancient astronauts who had something to do with the sudden appearance of *Homo sapiens* disproves Darwinian evolutionary theory and supports creationism, using arguments as half-baked and out-of-date as the Dogon myth.

It's just fiction? Anything for a story? Well, in fantasy perhaps. But in science fiction, we do pretend (despite traditions such as time travel and warp drives) to be dealing with the real world.

"Hey, Easton! Quit the bitchin' and get on with it!"

OK, OK. Scene 1, Mali, and anthropologist Samantha Colby have just discovered in a cave a skeleton with a big skull. Looks human, and it's a good

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age—30-50,000 years—but it has only four fingers per hand, and it accompanies a curious artifact. Samantha promptly sends for old flame Jack Austin, whose career has decidedly suffered for his ancient-astronaut enthusiasms.

The local Dogon just as promptly go ballistic, for the artifact is just like one of their religious icons, which supposedly lets them talk to their gods. The anthropologists, aided by Samantha's current boyfriend, arms dealer Ben Dorn, have to fight their way free. In the process, they capture the Dogon icon, notice that it is the other half of the dingus they found, and discover that the reassembled whole levitates, emits mighty beams of light, and displays a map that directs them to the ancient ruins of Tiahuanaco in Bolivia.

The astute reader, aided by the characters' pronouncements of inevitability, knows exactly what to expect. After a plane crash and a suitable slog through the jungle aided by hired goons from the drug cartel and watched by a pair of CIA agents reporting by satellite back to headquarters, they will of course discover an ancient alien base and evidence of an alien hand in the origins of humanity and civilization (and never mind that humans weren't in the Americas until long after the alien presence). Meanwhile, Samantha will realize that Jack was right all along and see his charms in a new light, while Ben Dorn gnashes his teeth, sniffs vast wealth, and assembles his armed mercenaries.

There's plenty of action and adventure here, but not much sense. Not recommended.

You'll find less action but much more sense in Maureen F. McHugh's latest, **Mission Child**. The setting is a time far enough in the future for planetary colonists to have forgotten their origins but not so far that names have changed from familar forms. Here is the town of Hamra, where offworlders have set up a mission to teach appropriate technology, the offworlders' English and literacy, and provide some medical assistance. The parallel to religious missions is clearly deliberate, as is the correspondence of the appropriate technology movement to a religion. So is the parallel to historical patterns here on Earth, for the people of Hamra are a subset of a clan-based society similar to the Sami of Lapland, adapted to an arctic clime and dependent on "renndeer," gengineered to turn indigenous vegetation into food for humans. The Hamrans are settled people, still remembering the older ways but now centered on the mission and trade. And here come the unreconstructed savages of Tekse Clan, armed with the new, offworld technology of guns. Massacre ensues, and poor little Janna, just a kid, flees with her boyfriend. In due time she has a daughter, who dies. They join the anti-Tekse forces, whose massacre this time she alone survives to make her way to a refugee camp, discover money and time-clock labor, learn more English, and the ways the displaced rural poor find to make a living in the shadows of a dominant urban-industrial society. For safety's sake, she disguises herself as a man, and she survives, and eventually she discovers.... What? The novel's end is not one of conclusive, shattering drama, but something quieter, a recognition of universality that I would spoil if I were more specific. One reacts with a "What? That's it?" and a moment later, "Oh. Yeah."

Janna is an interesting character. But McHugh's mission is much less to explore her than to explore the intersection of societies, the collision of "primitive" and "advanced," and though she grants that humans have learned a great deal from past collisions with Native Americans and Inuits and other groups, there is a huge amount of damage that cannot be escaped. At the same time, she reminds us, the key aspect of the collision need not involve relative levels of advancement, but foreignness in-

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stead. Some technology is good— "appropriate," if you will—yet its unfamiliarity can still create social problems. What is needed is someone who can bridge the cultures, someone like Janna who is both male and female, primitive and advanced, who knows the tongues of both locals and intruders.

Recommended.

It's neither science fiction nor fantasy, but it showed up in my mailbox with a nice little note from the editor, I gave it a look, and then I read it. And I enjoyed it quite enough to want to recommend it to you.

It's Wilder Perkins's **Hoare and the Portsmouth Atrocities**. The title might lead you to think of Lovecraft, perhaps, but give it a few pages, and you're thinking of C. S. Forester's Hornblower yarns instead. Except that Bartholomew Hoare (who will shoot holes in your gluteus maximus if you laugh at his surname) is a detective. He is also a lieutenant in His Majesty's navy of 1805 and exceedingly frustrated that his inability to speak above a whisper (his larynx was damaged by a spent ball) must forever keep him from a captaincy. But the Portsmouth admiral employs him as his "Whispering Ferret" for his talents at inquiry.

And off we go, with kegs full of clockwork, a sturdy woman who fights off assailants with a sling, an ingenious physician, a suspicious Canadian, a stolen rifle, enciphered messages, a murdered captain, assorted bodies, and an exploding ship. By the end of the tale, Hoare has a foster daughter, a widow to pursue, and a promotion to what sounds rather like the grandmother of all government intelligence services.

Hoare is a thoroughly enchanting cross between Horatio Hornblower and Agent 007. Fortunately, this slim book—"The first in a series of historical naval mysteries"—is not the last we'll see of him. The series looks like a great deal of fun, and I hope Perkins can keep it up for a good long time.

* * *

The Three Galileos: The Man, The Spacecraft, The Telescope is actually three books in one with a common theme. The first section deals with Galileo Galilei, the early Renaissance mathematician who developed the telescope into an effective scientific instrument and essentially moved our view of the Earth from the Center of the Universe to a lesser role as a small planet among many. The authors explore Galileo the tinker, tweaking his instrument and Galileo the objective scientist, able to observe but unable to touch the subject of his study. The second section deals with the Galileo Spacecraft, designed by the Jet propulsion Laboratory and launched toward Jupiter by NASA, arriving at the distant planet in 1995 before dropping a probe into the deep atmosphere. The book details history of the project, design details and data received up to the date of publication. Despite technical glitches, the continuing results of observations of the giant planet and its moons can be modestly described as wildly successful. The third section describes the 3.5 meter aperture Telescopio Nazionale Galileo, erected on La Palma, the Canary Islands. With active deformable optics to compensate for the atmosphere and sensitive "smart" light sensors, the telescope puts Italy on the map in World-class astronomical observatories.

The authors are historians, spacecraft designers or astronomers and the different voices do show in the writing. The mass of technical detail in the second and third sections is typical of academic papers since the book is a result of an academic conference held in Padova (Padua), Italy. The book also contains a fairly authentic looking parchment repleca of Galileo's notes and sketches on the evening he discovered Jupiter's moons. If the literary fare seems a bit rich for your tastes, it's still an excellent tome to suggest for your local library or school.■

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BRASS TACKS

Dear Stan:

Concerning your speculation in the December, '98, editorial about whether major corporations are engaged in making deliberate errors based upon the likelihood that few people will do anything about them, thereby cutting costs or increasing cashflow: I suspect you're underestimating the scope of the situation.

Last year my mother received a letter/bill from a book club, unctuously thanking her for her order. Problem was, she hadn't ordered anything from them. Ever. She wrote back and told them so. The following month she received a threatening letter from the club's collection agency. She turned it over to me. I reviewed the situation and concluded that this was indeed one of those bullying deceptions calculated to frighten money out of a senior citizen who probably could be counted upon just to send in the few bucks to make it all go away. Investigation revealed that a Mr. _____ was president of the club. I wrote him personally, told him my conclusion, told him to get the hell of my mom's back, and sent a copy of all correspondence to Janet Reno. Within three weeks Mom got a letter regretfully accepting her cancellation (of course, she hadn't canceled anything either), and letting her know that no further collection efforts would be forthcoming.

But it gets better. Several years prior to that, shortly after Dad's death, Mom had occasion to file an insurance claim. It was a valid claim, open-and- shut, clearly within policy regulations. Payment was refused without comment. I wrote and demanded details supporting their refusal. There was no response to me, but they paid Mom's claim within three weeks.

Now, my speculation regarding the insurance industry is that virtually all major insurance companies contribute to and share a vast demographic database. Coupled with this is some sort of sophisticated odds-maker program. When a claim arrives, the claimant's demographics are pulled from the database: a 74-year-old widow living in a paid-off home on the bank of the Silver Springs River in Ocala; with a three-year-old spayed registered Pekingese and a year-old spayed fluffy gray kitten who looks like Nermal; who drove an Oldsmobile; who lives on a combination of social security and invested assets; etc., etc. These demographics are pumped into and filtered through this odds-maker program, which spits out a number representing a claim amount below which the odds are very great that the specific claimant identified won't fight a denial, regardless of its validity.

The fact that her son was a court reporter, familiar with the court system, apparently was not in her database file. When I wrote them, that fact was added, which changed the go/no-go number, and the odds, and the claim was paid instantly.

Short of infiltration and/or widespread sting operations, I don't know how this premise can be confirmed or denied. And I'm not certain I want to live in a country where the government engages in virtue testing folks and/or corporations on a routine basis.

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On the other hand, this sounds like an ideal application for the Internet. If enough people, stung by dishonest corporations, compare notes, the numbers might rise to a sufficient statistical population to satisfy law enforcement.

Or, there might be enough of them just to get together, hire a troubleshooter, and have the bastards at the heart of the problem killed. As fond as I am of the law, there simply are situations it can't resolve.

It doesn't matter if you're paranoid if they're really out to get you. Then the question becomes: Are you paranoid enough . . . ?

DAVID R. PALMER

P.S.: You've been running a bunch of really fun stories. Keep up the good work.

Dear Stan,

I was struck by your comments at the beginning of your December 1998 editorial (Quality Control II: Reminder and Speculation); not so much for the main point, which is a suspicion I happen to share, but for the introduction. You recounted a reader's response to your suggestion that he should re-read a previous editorial for your answer to his question, and he objected to "the very idea of citing an old piece of writing as an answer to what he thought of as a new question."

The crux of that reader's problem lies in his belief that "what he thought of as a new question" was actually a new question. I have noticed a tendency of people who are either very young, or uninformed, to believe that no one has ever previously considered any problem or idea that the (young/uninformed) person has just encountered.

This is more forgivable in the young, for whom most things really are new, than in the uninformed, for whom it is either mental laziness or arrogance. (The young can grow out of this tendency, unless they grow into the uninformed.) For the uninformed, this tendency often takes the form of insisting that we don't need to pay any attention to history or the background of a current problem, because history is irrelevant. In addition to the inefficiency of reinventing the wheel, this leads to solutions which do not solve the problem, because in ignoring the background, the problem is not adequately defined.

I don't know the answer to this difficulty. I am depressed by the knowledge that it is a common difficulty in our society, which on average is old enough to know better. If a population of people aged 35-40+ is so massively uninformed (and mentally lazy/arrogant) that all problems are new, and others' previous experiences with and thoughts about such problems are irrelevant, it might explain a lot about our society!

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Dear Stan,

I usually read your editorials first when *Analog* comes and this month was no exception. I enjoyed the main part of your discussion and try to practice what you are preaching as much as possible. It really works. In my work, about 40% of my time is doing direct customer support on our rather complex products so I see the situation from both sides. I know we don't have a policy of ignoring customers until they give up because when they do they are gone for ever. Our products are sold in a total volume of under 100 per year so any defection is painful.

I once read an editorial, probably in an R&D magazine, with a title something like, "Thank God for the Complaining Customer." The thesis was that the complaining customer is giving you another chance to do it right while the ones who suffer in silence just won't come back. This is somewhat off your

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main point but another really good reason to encourage people to complain when they are treated badly. One way to look at it is that negative feedback makes possible our increasingly complex technological systems—why shouldn't it be useful in societal systems?

Finally I want to get to the thought which caused me to start to write this, your opening section on whether it is appropriate to cite a previous answer to a current question. I would say yes but only if it is really practical for one to access that answer. I have about 30 years of *Analog* but it is not organized in a way I could find a particular article without more effort than I would likely expend. If you think your editorials do have lasting value, as I do, why don't you see if they can be made accessible on the web? Then you would be able to give a URL and a date and move on to new stuff. The argument that a trip to the library is too much may fly but any *Analog* reader who doesn't have web access is reading the wrong magazine.

BRUCE MCINTOSH
ORBITAL SCIENCES CORP.

From the reader's point of view, it's clearly beneficial to have as much old material as possible archived on the web. From the writer's point of view, things aren't quite so clear-cut. Many writers depend for a significant part of their livelihood on sale of republication rights, and it may be hard to sell those for things that are permanently available for free. However, methods are evolving for giving writers payment based on people's use of electronically stored or published material, so I suspect we'll eventually have widespread ways of giving both parties what they want. Meanwhile, one thing I've personally been doing sometimes is this: when a new editorial refers prominently to an old one, I'll post the old one on the Analog *website for a while when the new one appears.*

I must also take mild issue with your last statement. Analog *readers are a very diverse lot, with a great variety of reasons for living in a great variety of ways. The web offers a lot of advantages that many people find useful and exciting—but there's no natural law that says everybody has to be equally enthusiastic about it, or that those who aren't are in any way inferior to those who do.*

Analog,

Several letters in the December 1998 *Analog* objected to points in Dr. Paul Levinson's article "The Book on the Book" (*Analog*, June 1998). I believe that those objections are invalid. In particular, the objections have more to do with the current state of the art and current inventories than they have to do with the nature of computers or the nature of books.

Amy Baggot states that, "printed letters (unless the printer messed up) come out as sharp, smooth lines. Letters on a computer screen, being made up of dots, tend to be blurrier." The fact is that printed letters are also made up of "dots"; the difference is in the size. As display technology improves, the resolution will get better, as will the refresh rate (which Ms. Baggot did not mention).

Bill Chamberlain states, "It seems to be an axiom that all worthwhile books and periodicals will be converted to a digital format." However, no such assumption is neccessary for the electronic book to become dominant. The publishing industry is already making heavy use of computers in the writing, editing and printing of books and magazines; all that is necessary is for them to start disseminateing the electronic versions that they already have.

As for the older books and magazines, they may be unavailable in electronic form, but they are mostly unavailable in printed form as well. Due to inventory taxes, most unsold books and magazines are remeaindered, and once a book goes

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out of print it becomes difficult if not impossible to find a copy. I've been trying to replace one book, "Design of a Computer System," for decades with no luck; had it been issued in digital form, there would have been no problem.

Mr. Chamberlain states, "... the entering would have to be redone every ten years." I've worked at several shops with tape drives capable of reading tapes 20 years old, in some cases 30 years old. More important, there would be no need to redo the data entry, just to copy and possibly reformat the files.

Mr. Chamberlain states, "Finally, a recurring concern was the question of who would maintain the huge database of noncurrent materials." But this issue exists with paper documents as well. Institutions periodically purge their collections, and the Library of Congress has been know to burn "excess" books without even offering the public an opportunity to purchase them.

Finally, Mr. Chamberlain states, "My fifteen year old daughter commented that the ability to sit on her dad's lap and be read to, while looking at pages and pictures, and to jump back and forth to different pictures, would not be the same with a computer." Her comment is certainly true pf contemporary laptops, but as technology improves it will almost certainly be easier to navigate through a book on screen than on paper, and present day palmtops are no more intrusive than paper books.

I've been working with computers for decades, and if there's one thing that I've learned, it's that things change. Yesterday's impossible is Today's expensive and Tomorrow's commonplace. This has already been proven for some aspects of electronic publishing, and I see no reason to expect other aspects not to progress in a similar fashion.

SHMUEL (SEYMOUR J.) METZ,
SYSPROG AND JOAT

Dear Stan:

The December 1998 "Alternate View" concerned an individual describing his health problems over the Internet. He's said to believe he has an "undiagnosed meningeal infection" requiring a "biopsy" and culture from the "dural/periosteal interface in the left temporoparietal region of his skull"—an infection now being suppressed by using antibiotics he's obtained without a prescription. It's suggested his physicians won't do the procedure possibly from fear of malpractice, belief that "negative" radiological tests indicate absence of a significant problem—or simple negligence.

This individual, though not a physician, is said to be very well-educated and intelligent, to have researched his symptoms in the medical literature, and to believes he's found what his problem is and what needs to be done where his doctors have failed. Is it possible for someone to do that? Of course. Physicians, like all human beings, are fallible. Is it *likely*? No.

Being a physician involves more than knowing basic medical terms, reading parts of textbooks, or citing journal articles. It also requires analyzing which symptoms, physical findings, and test results are relevant in an individual patient, and integrating those data into the best assessment and treatment plan possible by current medical knowledge. These skills develop only with experience and the *practice* of medicine over many years.

A number of conditions ranging from the mundane to the esoteric might be responsible for this individual's medical problems. However, it's impossible to determine exactly *which* of the condition(s) in his differential diagnosis he actually *has* based solely on the information in the article. A full description of his medical history, physical exams, and results of all diagnostic tests and treatments are not given. Also, only his ideas and perceptions are described, and not those of the physicians who've seen him. However, several issues in the article can be commented on.

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First, the concept of a "false negative" (absence of an abnormality on an X-ray or other test doesn't necessarily mean there's no problem) is basic medical knowledge. Physicians routinely take this and other limitations of tests into account when making clinical decisions.

Second, the procedure this individual believes he needs would require removing part of his skull—a procedure that carries appreciable risk, including introducing infection. In the absence of clear radiographic or other evidence of *exactly* where to do this and reasonable evidence this approach carries the best balance between risk and benefit, it's not certain this procedure would be the best alternative.

Third, the net effect of the "antibiotics" the man is taking is uncertain. That term encompasses many different types of medications, each of which is effective against only certain types of microorganisms. While it's often desirable to obtain samples of infected material for culture to see which microorganism is responsible, when such material can't be obtained without significant risk, empirical therapy against the one(s) usually causing a particular type of infection may well be the best of the available alternatives.

Long-term use of antibiotics may also select for resistant bacteria; make it more difficult to identify responsible organism(s) when infected material is obtained; and can have potentially serious side effects. Also, certain types of chronic infections (e.g. due to *M. tuberculosis* and fungi), are *not* affected by standard oral antibiotics. Thus, while it's possible the individual's use of whatever antibiotic(s) he's been taking might be suppressing an infection, it's by no means a certainty—and he may well be doing himself, on balance, more harm than good.

Fourth, I reviewed the two medical papers the individual cites concerning his medical problems. They describe conditions (spinal epidural abscess and acute subdural empyema) which, based on the information in the article, he is *extremely* unlikely to have.

In short, it's quite conceivable the physicians who've seen this individual *have* given him an honest, medically valid appraisal—and decided the treatment he believes he needs is not the most appropriate. What he seems to need most is to find another physician (e.g. one who specializes in infectious diseases) who can review his previous records, evaluate his current condition, take the time to discuss their assessment of his problems, and answer his questions and concerns. That's not, of course, a perfect solution. But, I believe, it' s the approach *most* likely to help him.

HENRY G. STRATMANN, M.D., F.A.C.C.,
F.A.C.P. PROFESSOR OF MEDICINE, ST. LOUIS
UNIVERSITY SCHOOL OF MEDICINE ■

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UPCOMING EVENTS Anthony Lewis

May 1999
(dates not announced at press time) MARCON 34 (Central Ohio SF conference) at Hyatt Regency Columbus, Ohio. Guest of Honor—Lois McMaster Bujold, Artist Guest of Honor—Robin Wood, Comics Guest of Honor—Julius Schwartz. Registration—$35 until 30 April 1999, $40 at the door. Info—Marcon 34, Box 141414, Columbus, OH 43214. Phone—614.470.5448; email—info@marcon.org; URL—http://www.marcon.org

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21—23 May 1999
CONDUIT 9 (Utah SF conference) at Airport Hilton, Salt Lake City, Utah. Guest of Honor—Terry Brooks; Artist Guest of Honor—Michael Goodwin. Info—CONduit 9, Box 11745, Salt Lake City UT 84147-0745. Phone—801.294.9297; email—conduit@conduit.hum.utah.edu; URL—http://www.business.utah.edu/~dofjhw/CONDUIT/

21—23 May 1999
KEYCON 16 (Manitoba SF conference) at Winnipeg, Manitoba. Guest of Honour—David Drake; Artist Guest of Honour—Den Beauvais; Fan Guest of Honour—Al Jastrom. Registration—CDN$40 until 30 April 1999, CDN$50 at the door. email—stornel@icenter.net; URL—http://www.icenter.net/~stornel/leycon/Keycon.htm

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28—31 May 1999
WISCON 23 (Feminist-oriented SF conference) at Concourse Hotel, Madison, Wisc. Guests of Honor—Mary Doria Russell, Terri Windling. Registration—$40 until 1 May 1999, $50 at the door. Info—WisCon c/o SF3, Box 1624, Madison, WI 53701. Phone—608.233.8850. email—wiscon.concom@lists.best.com; URL—http://www.sf3.org/wiscon/

2—6 September
1999 AUSSIECON THREE (57th World Science Fiction Convention) at World Congress Centre, Melbourne, Australia. Guests of Honour—George Turner (in memoriam), Gregory Benford, Bruce Gillespie. Registration—$155 (A$225); supporting $35 (A$45)until 1 January 1999.[These are the latest posted rates and reflect the change in the Australia dollar as of the time this column went to press. Rates may go up after 1 January 1999.] This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Info—Aussiecon Three, GPO Box 1212K, Melbourne VIC 3001, Australia. US Agent—PO Box 266, Prospect Heights, IL 60070-0266. URL—http://www.aussiecon3.worldcon.org

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4—7 November 1999
WORLD FANTASY CONVENTION/VOYAGES at Rhode Island Convention Center, Westin Hotel, Biltmore Hotel, Providence, R.I. Guests of Honor—Patricia A. McKillip, Charles de Lint, Robert Silverberg, Leo & Diane Dillon; Special Guest—Samuel R. Delany; TM—John M. Ford. Registration—$85 until 30 November 1998, then more (limited to 850); $35 supporting (payable to MCFI). Info—World Fantasy Convention, c/o MCFI, Box 1010, Framingham, MA 01701-1010. Fax—617.776.3243; email—wfc@mcfi.org; URL—http://www.mcfi.org/wfc ■

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Hot Pick!

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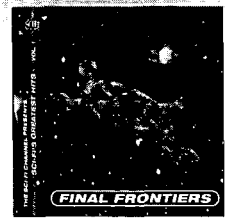
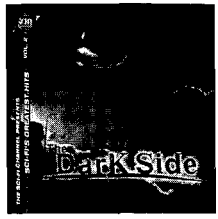
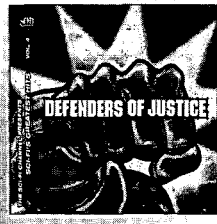




to the darkest corners...

and from alien encounters...



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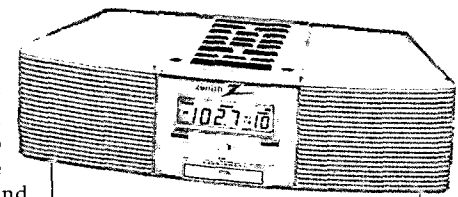
TECHNOLOGY UPDATE

Big sound from a stereo radio—without the big price!

Zenith Audio, a leading electronics manufacturer designs a "Small Footprint," "Big Sound" stereo system and drives the price below $100.



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Zenith Audio has developed a Digital Stereo Clock Radio that boasts the acoustic quality and practical features of stereo radios four times as expensive. You'll be amazed at the sound quality and powerful bass you get from a radio this small and this affordable. This stereo radio features an 11-key handheld remote control and an input jack for CD players or other audio sources.

Loaded with features. The AM/FM radio features digital tuning for pinpoint reception and crystal-clear sound. The STEREO indicator allows you to tune in to the stereo signal. It also picks up TV and WEATHER signals with 13 TV channels and 7 Weather channels, so your Zenith Audio Clock Radio is a great source of news, entertainment and information. You can program the unit's memory for 37 preset stations, and the tuning buttons can operate either manually or in a automatic search mode.

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Factory direct risk-free offer. You can spend hundreds of dollars more on a stereo radio, but why do it? We get the Stereo Clock Radio direct from Zenith and pass the savings on to you. This product comes with a one-year manufacturer's limited warranty and Comtrad's exclusive risk-free home trial. If you are not satisfied for any reason, simply return it within 90 days for a full "No Questions Asked" refund.

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